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REPRESSION, RELEASE AND NORMALITY

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It is the task of the present study to outline a psychological account of the three concepts of repression, release and normality which hold a fundamental place in psychoanalytic theory. To-day there is an evident tendency for lines of treatment in psychiatry and psychology to converge. Psychology is developing definitely in the direction of dynamic explanations and theories. And the psychoanalysis of the American school at least is dealing more and more in terms of the organism and human behavior. And so, in spite of many unfortunate antagonisms and misunderstandings, the time seems at hand when it will be possible to subsume the findings of the pathologists under a single science of mental life, with great and obvious systematic and practical advantage to both sides.

At the outset it is necessary to make a note on terminology. The distinction is often made between repression and suppression, suppressed tendencies grading from clear to vague consciousness, and repressed tendencies from vague conciousness to unconsciouness. Such a distinction has its importance in the classification of the neuroses. For this discussion, however, it is not significant, and I use the term repression to cover all the phenomena.

I. REPRESSION

A repressed tendency may be described as one that has ceased to be fully conscious, but which nevertheless directly

conditions behavior and experience. This is precisely equivalent to what Rivers means by dissociation when he writes: "A dissociated body of experience is one which is separated from experience readily accessible to consciousness by some kind of obstacle only to be overcome under special conditions, such as sleep or hypnosis."[1] One of the crudest errors in interpreting psychoanalytic ideas is that any frustrated tendency necessarily becomes repressed. This, however is a suggestion often encountered in psychological discussions. A great many elements in mental life which undergo frustration are not repressed, but merely forgotten. They may still affect behavior and experience, but unlike repressed elements, do so only indirectly by their modifying effect upon habit structures. Thus such a criticism as that of Woodworth,[2] to the effect that mere forgetting is much more common than repression, is beside the point. Every psychoanalyst would admit it. What we have to do is to analyze the special nature of repression as just described, and the conditions under which it occurs.

It is of the first importance that we appreciate at the outset how absolutely essential is the notion of repression to psychoanalysis. Burrow quotes Freud as asserting at the Fourth Psychoanalytic Conference: "It is not the discovery and counting and tabulation of complexes that is the object of psychoanalysis, but the sole object of psychoanalysis is the overcoming of the patient's resistances." And later he himself goes on to say: ". . . the meaning of psychoanalysis becomes synonymous with the psychology of resistances."[3] The startling views of sex associated in most minds with this school, while they have their important place in the scheme, have measurably deflected attention from the crucial point. If there be no such thing as repression then psychoanalytic therapy and psychoanalytic theory

[1] W. H. R. Rivers, 'Why is the Unconscious Unconscious?' *Brit. J. of Psychol.*, 1917–9, **9**, 238.

[2] R. S. Woodworth, 'Some Criticisms of the Freudian Psychology,' *J. of Abnorm. Psychol.*, 1918, **12**, 174.

[3] Trigant Burrow, 'The Meaning of Psychoanalysis,' *J. of Abnorm. Psychol.*, 1917–8, **12**, 53.

collapse. It should be said with emphasis that no psychological evaluation of psychoanalytic concepts which ignores repression—and there have been many such—is worthy of the least consideration.

Our objective, then, is to work out an account of repression which shall really square with and explain the facts. In doing so we shall first pass in review a number of criticisms of the notion, and then a number of partial positive theories. But before we come to this it seems advisable briefly to marshal the evidence that is offered in support of the notion. There are four main groups of facts which it is claimed go to support the hypothesis of repression. First, there are errors of various kinds, such as slips of the tongue and pen, forgetting, and so forth, through which the repressed elements are said to come to the surface of behavior. Second, there are dreams, which it is said are invariably wish-fulfillments. Third, there are the psychoneuroses. Fourth, there are the phenomena of hypnosis which engaged the attention of earlier workers, and which have recently been used experimentally with positive results. It is worth while specifically noting that we cannot accept as serious evidence those fanciful analyses of literature, folk-lore, art, religion, and what-not which have been produced with such fecundity under the general inspiration of the psychoanalytic method.

When I come to deal with the concept of release I shall have occasion to examine in some detail the first three of these groups of phenomena, and I shall ask in what precise sense repression and escape from repression are involved in each case. My present question, however, is whether the hypothesis of repression is feasible as an explanation of these facts. Freud's point of view is that on general scientific principles we must assume a cause for any class of phenomena, that no other adequate cause has ever been suggested for these, and that while the account he has to offer may not be final and perfect, it is a genuine explanation at least up to a certain point. There has arisen a body of criticism which denies this claim, and I turn to it before coming to a positive study of the nature of repression, which I believe makes it possible to improve upon the Freudian notion.

A. Extreme criticism would reject repression as an explanation of the above-mentioned facts on the ground of inherent inconceivability. Among the mass of more or less intelligent and relevant comment, three main points emerge. Woodworth, in commenting on the censor, argues that since very powerful tendencies are driven into the unconscious, this must be the work of an agency still more powerful, and asking whence the censor derives such power, finds no answer.[1] I doubt if this is in reality a very serious puzzle, even as we find it stated here. For presumably the censor represents the general sanctions of morality, and one should be able to account for its being 'powerful' enough. But quite apart from this, it seems a sufficient rebuttal to point out that the analogy of physical force is both gratuitous and misleading. It presupposes a dynamic relationship in experience which cannot be imagined to subsist. A second criticism which Woodworth makes is that we cannot believe that an instinctive drive actuates behavior foreign to it, as the theory of sublimation at least would perhaps involve. Here the sufficient, though again not the complete reply is that we do not have to use the concept of instinct at all. It is true that we read a good deal about instinct in psychoanalytic discussion, but as a matter of fact the writers use the term very loosely, and would do better without it, as they leave themselves open to attack on an unessential point. The third, and by far the most important critical point, is expressed by Woodworth as follows: "Freud is apparently guilty of yet another error in supposing that any specific wish, ungratified, lives on as the same, identical, precise wish."[2] The question of how repressed tendencies maintain their identity and persist—why, that is, they *are* repressed and not merely forgotten, is a systematic point of the highest importance. No brief reply is possible, and this consideration will orient our whole positive discussion of repression.

B. More moderate criticism would rate the evidence for repression as inconclusive. Repressions, it is said, may exist,

[1] R. S. Woodworth, 'Some Criticisms of the Freudian Psychology.'

[2] R. S. Woodworth, 'Psychology,' p. 568.

but their effect is very difficult to determine precisely and is probably not so important as the psychoanalysts suggest. Thus Stephen writes: "Now I would not dispute that what are called repressions may in fact have a very serious effect on the psychic condition of the subject. What I do feel inclined to dispute is that every abnormal state of mind which leads to the discovery in the subject of a repression is necessarily the result of that repression."[1] And Woodworth argues in several connections that owing to the complexity and wealth of an individual's associative connections, the method of free association can never validly establish a causal connection between an abnormal psychical event and a determinate complex. He insists that free associations are 'easy running' and may lead anywhere. As against this we may say first that a psychoanalysis is no haphazard exploration of a jungle of free associations, but that it has a recognisable objective and stops when this is reached. And secondly Woodworth's view of free association looks very much like pure indeterminism.

These criticisms then do not render untenable the hypothesis of repression as an explaining concept. And out of them arises the very important systematic problem of the continued identity of repressed elements—how 'any specific wish, ungratified, lives on as the same precise identical wish,' a problem which the theory of repression has to consider. In turning now to the consideration of the positive nature of repression I raise two general questions, first as to the mechanism and second as to the occasioning of repression.

1. *The Mechanism of Repression.*—We review a number of attempts to deal with this problem.

(*a*) The trouble with the notion of the endopsychic censor is that it is a poor principle of explanation. Freud himself uses it so carefully that obvious and crude objections fall to the ground. "The term 'dream censor' is no more than a very convenient phrase for a dynamic relationship."[2]

[1] Adrian Stephen, 'On the Assumptions of the Psychoanalysts,' *J. of Abnorm. Psychol.*, 1918, **13**, 18–19.

[2] Sigmund Freud, 'A General Introduction to Psychoanalysis,' p. 114.

XUM

Here we have no ill-considered personification, and attack along this line can only be against a man of straw. But the idea of the censor leaves far too much unexplained. Even within its own special province it is often partially overcome, as in the anxiety dream. Furthermore, the censorship is extremely variable, notably of course as between sleep and waking, and this itself needs explaining. Lastly it in no way touches our central problem of the continued identity of repressions. We are forced back of the 'convenient phrase,' to a further analysis of the 'dynamic relationship,' and cannot regard the notion as at all adequate.

(*b*) A number of explanations along biological lines have been advanced which are decidedly unsatisfactory, and of these I consider two. The view of Rivers is that unconscious elements are the cruder impulses properly belonging to an earlier stage of development, and that these are repressed by the more finely graded functions superimposed upon them. This, however, seems far from satisfactory. The phyletic analogies which reinforce the idea seem hardly relevant. The separation between the epicritic and protopathic functions, which is drawn from specialized neurological research, is hardly tenable of behavior as a whole. And the whole theory seems somewhat too far removed from the actual facts—errors, dreams, hypnosis, and the psychoneuroses—which it is designed to cover.

The second theory, which deserves only the most passing reference, is that of pseudohermaphroditism, which would make repression a direct and demonstrable consequence of our phyletic history. Whatever its morphological value, perhaps the most charitable comment on its psychological significance is that it is fanciful. The derivation of character traits from a conflict between masculinity and femininity in the individual is somewhat far removed from the possibility of factual verification.

(*c*) Kempf has worked out an explanation of repression in terms of a theory of the autonomic functions. "When an affective craving or particular autonomic disposition is prevented from attaining adequate neutralization a heightened

postural tension in that particular autonomic segment, as in the anxious tensions that follow the loss of a love-object, seems to persist. It then exerts a constant pressure to be relieved. . . . As an affect-producing mechanism the hypertense autonomic division may be said to be *repressed* when it is not permitted to make the organism conscious or aware of its needs."[1] Of this account two criticisms are relevant here. First, in so far as it tends to separate out the autonomic as against the projicient system, and to make it primary and the other secondary, it is dealing in abstractions. As Watson remarks, despite the phyletic primacy of the autonomic as against the proficient, to-day the tail wags the dog. Second, Kempf is not able to cite convincing facts to show that the autonomic disturbance may persist indefinitely as it presumably would have to do to maintain a repression of long standing, and thus the fundamental systematic difficulty noted by Woodworth is not met.

(*d*) According to Watson, the phenomena of dissociation are to be taken in terms of habit distortion. " . . . we can have a diseased personality arising through habit distortion—distortion carried to the point where compensatory factors (serviceable habits) are not sufficient to carry the individual along in society. He is out of touch with his environment and unless help is given him he will most certainly go down under competition."[2] The persistence of infantile forms of sexual behavior would on this hypothesis merely be the persistence of habits no longer appropriate to the needs and status of the adult. This is indubitable as far as it goes, but its adequacy is open to question. Taking Watson's own illustration of the mother whose mental stability was seriously threatened when she was no longer able to sleep with her grown son, we have more than mere habit distortion as ordinarily understood. We have more than a negation or absence of adjustment, but positive maladjustment, that is, a craving. And I think this would be so for all pathological cases.

[1] E. J. Kempf, 'The Autonomic Functions and the Personality,' pp. 139–140.

[2] John B. Watson, 'Psychology,' p. 419.

XUM

The last two views, however, directly suggest what seems like an adequate and correct account. An autonomic disturbance tends, as Kempf explains, towards neutralization. But if the effort at satisfaction fails, then this piece of behavior which at the time tended in the right direction, may become fixated as a habit. And such a habit will make towards the constant reinforcement of the underlying autonomic disturbance. This would adequately explain how a repression might persist for a length of time without losing its identity, for we would account for this in terms of the general fixation tendencies of the organism. And, furthermore, we have here a theory which seems able to cover all the facts. A further analysis of repression will bring in reinforcing evidence in favor of it, and we shall find that it leads to a workable account of the nature of release.

2. *The Occasioning of Repression.*—It is often difficult to glean from general works on psychoanalysis just what type of situations give rise to repressions, or what kind of tendencies are likely to be repressed. Freud's own generalisation, though not unilluminating, lacks specificity. "The tendencies . . . against which the dream censor directs itself must now be described, . . . one can say only that these tendencies are those of an objectionable nature, that they are shocking from an ethical and æsthetic point of view, that they are things one does not dare even to think, or thinks of only with abhorrence. These censored wishes which have attained to a distorted expression in the dream, are above all expressions of a boundless, reckless egoism."[1] Now according to this, almost any given wish may be repressed, for on occasion almost anything may appear 'shocking.' According to Rivers the war neuroses arose out of repressed tendencies towards self-preservation, which are not ordinarily in the least 'shocking.' The point of course is that repression operates against any tendencies conflicting with the existing social code. This is its occasion.

That the social environment is of determining importance here has been pretty well recognised, but so far as I know the

[1] Sigmund Freud, 'A General Introduction to Psychoanalysis,' p. 115.

precise principle of its operation has never been formulated. Yet it is clearly indicated in the fact that the prevailing tendency of our deepest and most persistent repressions is sexual. Why is it that it is above all the sexual wish that is 'shocking,' or that 'a boundless, reckless egoism' is especially apt to work out along this line?

It is because of the peculiar ambivalent attitude of society to sexual behavior, in that it at once incites and regulates it. Interesting testimony as to the volume and constancy of sexual stimuli which impinge upon us day by day, not clearly recognised, but assuredly not ineffective, is found in the fact that in parts of South Africa certain types of advertising of feminine wearing apparel have to be forbidden on account of its effect on the blacks. What to a white man trained to civilized usage means little or nothing may to an unsophisticated semi-savage be incitement to rape.

On the one hand, then, the social environment is perpetually suggesting sexual activity. On the other hand it not so much suppresses as regulates it. This is done characteristically by setting up norms of conduct for different age-groups and sex-groups. Behavior, say of an exhibitionistic type, which is allowable in the prepubescent, is frowned upon in the pubescent. Again society in effect (whatever may be urged by moralists to the contrary) condones behavior in the pubescent boy which would be highly reprehensible and conspicuously abnormal and disgusting in the adult. Again we may cite the tendency to wink at the sowing of 'wild oats' at a certain time of life, which after marriage becomes quite another matter. The 'double standard' of morality is also a case in point. Or again one might mention the numerous and ironclad conventions which surround engagement and marriage. Of course there are other activities which are regulated in something the same way, but not, I think, to at all the same extent or with the same minuteness as this. In order to avoid perpetual conflict with his environment the individual has to readjust and alter his sexual habits many times, and in many directions.

Now here it is obvious that we have the stage well set

for habit distortion in Watson's sense. An earlier set of habits will not do later on, or in a different situation. And then too we are dealing with a type of behavior characterised by autonomic disturbances only exceeded by those of hunger, at least in normal life. And so arises a dangerous situation. All the occasioning factors for repression as we have come to understand it, are present. The various social norms may fit the normal development of the individual fairly well. But educational instruments are not perfect and parents not omniscient, and the transition from stage to stage may be forced or retarded, or otherwise complicated. And here we find the direct occasion of repression. We find this not in the inherent character of the sexual or other impulses, but in the nature of the social environment as it imposes itself on the individual, with its unique combination of reinforcement and regulation. Repression is a function of the integration of a developing personality in the social environment, and here we seem to have a notion theoretically sound, and meaningful both for psychology and psychiatry.

II. Release

To understand what is involved in the concept of release it will be necessary to consider in some detail the cases where it is alleged to operate.

1. *Errors, Slips of the Tongue and Pen, Memory Failures, Etc.*—Freud considers that all these represent the release of some repressed wish. Such a universal statement is of course very difficult to prove. It may well be that many errors are due merely to some such factor as perseveration—we must be on our guard against saying that they are mere accidents. And equally we must be on our guard against merely fanciful explanations to which the inaccurate use of psychoanalytic notions undoubtedly tends. But if an investigation is competently performed—that is, if some given error is analysed down to a point where the subject recognizes a complex as causal—it would seem hard to deny that a case has been made. And if a conclusion is confirmed by further observation, that case is strengthened. An instance

of this would be that of the wife who failed to recognize her husband on the street, and whose marriage was later broken off in distressing circumstances. We can hardly doubt that many, though probably not all errors really involve release, that is, the outworking of a repression through substitute material.

2. *Dreams.*—Woodworth would apparently call in question the almost classic dictum that dreams are the expressions of repressed wishes. His most important systematic argument is stated as follows: "The objection to Freud's theory of dreams is that he fails to see how easy-running the association or recall mechanism is. It isn't necessary to look for big, mysterious driving forces, when we know that *A* makes you think of *B*, and *B* of *C*, with the greatest ease. The dreamer isn't laboring, he is idly playing, and his images come largely by free association with personal desires giving some steer.'[1] The reply is threefold. First, the idea of 'big, mysterious driving forces' is one that can hardly be entertained in psychology at all. Force is a concept of doubtful validity in physics, and in psychology it is impossible. Thus this particular point is irrelevant. Second, to repeat what has already been remarked, this view of free association seems to involve indeterminism. It is association that is 'free' not in the laboratory sense of proceeding without instruction, but in the metaphysical sense of being uncaused. The mere fact that association is 'free' or 'easy-running' does not absolve us from trying to explain it. Third, this criticism simply ignores the large number of cases of dream interpretation that have been accumulated. And facts cannot be treated cavalierly in the 'high *apriori* way' just because one does not like them. Tannenbaum assembles the evidence that dreams are releases of complexes under the following points among others. He says that the dreams of childhood are manifestly and directly wish-fulfilling; that many dreams not so obviously wish-fulfilling can easily be shown to belong to this class; that anticipation and consolation dreams are further evidence of the Freudian view;

[1] R. S. Woodworth, 'Psychology,' p. 507.

that the only explanation of many dreams of the satisfaction of bodily needs, hunger, thirst, etc., is that they fulfill wishes and make possible the continuance of sleep; that thinly disguised sexual dreams are familiar to everyone's experience; that thousands of applications of the free association method to the dreams of adults have shown that these have a latent content; that experiments with the use of hypnosis, where it is suggested that the subject dreams something afford direct evidence of dream distortion. And he asks why, if we assume that all psychical events are caused, we should refuse to admit this of dreams as well.[1] Once more then we must conclude that in the dream we have a genuine instance of release, in that the repression makes use of substitute material.

3. *The Psychoneuroses.*—These are generally admitted to be mechanisms of release. It should be remarked that if we admit these, the case against the dream is very much weakened. For Freud has successfully shown the close analogy between the dream and the neurosis. Woodworth, it is true, tries to make a distinction by saying that the neurosis is heavily charged with emotion, and the dream is not. But this is hardly in line with the facts. A nightmare may be powerfully emotional while in some neurotic cases there seems little affective disturbance evident. In the neuroses, of course, we have the very best picture of release, for here the dissociated elements are relatively speaking in full charge, and the substitutions very elaborate and striking.

It will be seen from these three types of cases that true release involves a complexity of which no explicit account has yet been given, for always we have the use of substitute material. Now our view of repression sufficiently explains how it is possible for an element to maintain its identity and at the same time express itself in varying material—that is, for instance, how a series of dreams may differ widely in manifest content, but remain identical in latent content. The distorted habit set is continually subjected to the subtle

[1] S. A. Tannenbaum, 'Some Current Misconceptions of Psychoanalysis,' *J. of Abnorm. Psychol.*, 1917–18, **12**, 390.

and pervasive pressure of the social environment. It cannot then remain exactly the same in all details. Exhibitionism, for instance, cannot wholly retain its crude infantile form. The change, however, will not be so radical as to involve a satisfactory readjustment of the whole personality and a neutralization of the affective tension. We shall have to discuss cases where this occurs in a moment, and shall find them so different from the instances we have been discussing that it seems hardly proper to say that they involve true release at all. In general true release is the partial conditioning of a distorted habit set. This formulation seems preferable to that of Kempf, who would speak merely of the conditioning of the affect itself. As we have seen, the bare affect is more or less an abstraction. And certainly we have very little idea of how an affect may become conditioned, if at all. Furthermore, it is much more satisfactory than the account of Freud, who does little more than assert the fact of release without attempting a rigorous analysis of its psychological mechanism.

I now consider two types of alleged release—successful psychoanalytic treatment, and sublimation—which involve a very different structure.

Kempf describes a successful psychoanalysis as follows: "When through the psychoanalytic method, because of freedom from restraint, the repressed (forgotten) painful experience is recalled, a disturbance of the patient's behavior occurs. After the affect has been permitted to readjust itself, as in anger, by saying whatever the inclination requires, the patient often adds something about being relieved, or 'feeling better.' Symptoms of function derangement, as well as persistent thoughts, disappear and the individual gives many indications of having made an affective *readjustment*, in which the hypertense or hypotense condition of some viscus, such as the bladder, stomach or vocal chords, disappeared as the organ resumed its normal functions."[1]

I think then that we must decide as against Woodworth that the treatment is really effective and lives up to its pre-

[1] E. J. Kempf, 'The Autonomic Functions and the Personality,' p. 118.

tentions. It is no haphazard exploration of lawless free associations, but works down to recognizable, and demonstrably causal complexes. And the pragmatic argument which he repudiates holds water inasmuch as psychoanalysis relieves cases which are untouched by other methods, at least where time and opportunity make possible a thoroughgoing treatment. But I do not think we can say that we find in it release proper. The situation is entirely different from that in errors, dreams, and the neuroses. We do not find the characteristic compromise formations making their appearance. Affective readjustment 'as in anger, by saying whatever the inclination requires' is compensation, not compromise. And secondly the whole status and relationship of the subject is highly special and unique. The patient is in intimate and sympathetic *rapport* with the practitioner. In effect the psychoanalyst is the representative who sympathetically mediates to the patient the demands and standards of normal life and the social environment. Instead of fearing that his sysmptons (distorted, partially conditioned habit sets) will be met with uncomprehending hostility, the patient finds society, in the person of his physician, sympathetic, comprehending, and helpful. It is his chance to readjust effectively to a normal level of behavior. This situation is recognized in the important notion of affective transfer as between patient and practitioner. Thus, in essence, the psychoanalytic *séance* is the creation of a sympathetic atmosphere in which repressions are not so much released as conquered and superseded. Here again Freud's words are significant: ". . . the sole object of psychoanalysis is the *overcoming* of the patient's resistances."

In sublimation we have an exceedingly vague concept. For a standard definition we may cite Bridges. "Sublimation (is) expression of the repressed wish in a socially serviceable way, as in art, poetry or religion."[1] The vagueness lies above all in the words 'socially serviceable.' Sublimation among savages might take the form of human sacrifice, among feudsmen, of the extermination of an enemy's family,

[1] J. W. Bridges, 'An Outline of Abnormal Psychology,' p. 38.

among criminals, of murder or robbery. These things are not at all socially serviceable in the sense in which we ordinarily find the notion of sublimation worked out, but in their essential structure they might be sublimations. The central point is that sublimation is the successful expression of repressed elements in the existing social medium.

Now in our cases of true release we have always found social maladjustments. And when we come to successful and triumphant social adjustment, the relation between the alleged repressions and their consequences is by no means clear. It should be noted that sublimation cannot be thought of as compensation. A shattered love affair may lead to a burst of hard work, but it is impossible to prove satisfactorily that the work is erotically motivated. Rather it arises from the desire to forget. We have compensation, not sublimation.

The truth is that sublimation is fundamentally a misleading idea. Let us begin with a very favorable instance. We will imagine an impotent individual who becomes a great inventor (creator). The familiar explanation is that here we have a sublimation of the creative impulse. But this can never be proved. We have postulated a picturesque dynamic relationship without a particle of real evidence. And this is a very favorable instance indeed. When we come to accounts of the religious behavior or æsthetic interests of normal people as sublimations of the sexual instinct, the affair becomes merely ludicrous. Not only is it impossible to find any direct substantiation of the interpretation, but the logic of the whole suggestion is untenable. The idea is, of course, that such individuals have successfully adjusted all their repressions. But so far as one can tell, no repressions —that is, no distorted habit sets accompanied by cravings— ever existed. When the habit structures are progressively adjusted to social and environmental requirements, or in other words, when we have affective progression, repressions simply do not occur to any important degree. To regard religion and art merely as elements in a mental hygiene without which we would inevitably be neurotics is gratuitous to say the least. True mental hygiene consists in continuous

successful adjustment to social reality at each stage of life. It is preposterous to try to explain behaviors in terms of release, when the very structure of the behavior in question reveals nothing to be released, because nothing has been repressed.

Our conclusion then is that neither in psychoanalytic therapy nor in sublimation is there any true release. The well-sublimated personality is merely the normal, well-adjusted personality, which escapes habit distortions, and in which affective hypertensions and hypotensions cannot long be maintained.

III. Normality

The rapid development of psychiatry makes the question of the constitution of normal personality exceedingly interesting and important. The psychologist asks whether there is any essential difference between the normal and the abnormal, and whether we are to deal with the normal in terms of the abnormal or vice versa. The pyschiatrist has a concern with the nature of normality, since normal personality is always the ideal present in his treatments of cases.

William Allan White in many places insists that the abnormal is nothing more than the unusual, and denies any essential internal difference. Surely, however, to bring a low-grade moron, Shakespeare, and a dementia præcox case under one category is to ignore vital distinctions. We may perhaps narrow the scope of our general question by accepting Goddard's distinction between psychopathy and abnormality in the sense of unusual I.Q. Thus we come to ask what is psychopathy.

Janet's point of view, which would make effective control by the higher psychical functions (high psychic or neural tension), the characteristic of normality, would suggest an essential difference between the psychopath and the normal. So too would our analysis of sublimation, for we found that the well-sublimated personality fails to exhibit the mechanism of repression and release to any important degree. We must, however, be very much on our guard against saying that a

normal individual is one who has no repressions and who needs no avenues of true release. For everyone dreams, everyone makes errors, and most of us enjoy and perpetrate jokes. Nevertheless we have a criterion. If the substitute formations in release are such that they never clash with the social environment, we have no psychopathy. As soon, however, as the individual begins to withdraw from social reality we are in the danger zone. In fact the profundity of the disturbance can be measured in terms of this withdrawal. " . . . the neurotic strives for power, the psychotic *is* the emperor, the President of the United States."[1] Indeed the psychoneuroses have been classified as benign or pernicious according to the depth of this withdrawal from social reality.

The ordinary dream is not a pathological phenomenon, for by the very conditions of its occurrence it cannot issue directly in an important clash with reality. This practically holds true of errors. And in wit we have the most defiantly successful of all release types. Though repression and true releases are involved in all these cases—though their mechanism is identical with that of the psychoneuroses—we have no psychopathy, because there is no withdrawal from or quarrel with reality. When we come to day dreams and moral holidays we are dealing with marginal cases. Nevertheless we must not think of the normal person who yet dreams and indulges in wit as getting rid of important repressions along the lines of religion, art, or general social service. Repression for us essentially involves habit distortion. If it becomes important then the whole life is disoriented and disjoined from reality. So the concept of sublimation seems self-contradictory. To clinch this distinction between the normal and the psychopathic we may cite Freud on sleep rituals. He tells us that pathological sleep rituals differ from those of normals not only in being more pedantic and elaborate, but in involving a complex hidden meaning, whereas everything the normal does is easily understandable.[2] In other words, the normal person integrates in terms of reality, and the abnormal does not.

[1] W. A. White, 'The Foundations of Psychiatry,' p. 107.

[2] Sigmund Freud, 'A General Introduction to Psychoanalysis,' p. 228.

XUM

This is essentially the psychoanalytic conception of normality. To secure normal adjustment of this type is the ideal of the psychoanalytic treatment, where the practitioner is the sympathetic and undertanding representative of social reality. The ideal may be formulated in a number of ways. The introverted type is predisposed to maintain repressions and to release them in socially impossible ways. It should be noted that the normal extrovert does not release repressions in socially successful ways, for the simple reason that he has no repressions to release at all except such as can be taken care of during sleep, by wit, or by slips of the tongue, pen, or what-not. Again regression means a relapse to old and inappropriate modes of behavior which are to some extent modified from their crude original form, but not much. And affective progression, which is the same thing as normality, is being up-to-date and adequate in behavior, so that repression has no part to play.

We are now in position to sum up on the general relation of psychoanalysis to psychology. Psychoanalysis is of importance in having brought to light certain complications in behavior which were not previously recognized, as well as in devising a technique to deal with them. These complications—repressions and releases—may, however, be formulated in terms of well-known and tried psychological categories. Furthermore, all behavior does not exhibit them, and in themselves they do not constitute the essence of psychopathy. They are present in the life of every human being, for the development of personality is a rough job and repressions and distortions are bound to be left over. But so long as the individual is equal to environmental demands and able to live substantially up to the social norms the mere presence of certain mechanisms does not make him a psychopath. If the mechanisms centrally dominate behavior, then, to be sure, we have psychopathy, not because of their own intrinsic structure, but because as they essentially involve dissociation and substitution, they lead to a withdrawal from reality the moment they begin to play an important part. They are based on distortion, and a personality importantly distorted

XUM

is by definition pathological. And on the other hand we must be clear that normal behavior is determined by quite another structure of motives. We cannot explain everyday life in terms of repression and release.

Purely psychoanalytic interpretations of social development, such as that of Rank and Sachs, for instance, operates with the ill-defined concept of sublimation, and is logically untenable in that its systematic basis is too narrow. It vastly over-simplifies human nature, and cannot really account for the facts. It has, however, raised the whole question of the springs of human action in a very fresh and cogent manner, and has made it very evident that what we need is a really thoroughgoing and logical analysis of the whole problem of motivation.

AN EXTENSION OF PILLSBURY'S THEORY OF ATTENTION AND INTEREST

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As conditions of attention, Pillsbury[1] lists two groups, the objective and the subjective. In the former he includes intensity, size, contrast, isolation and change; in the latter idea in mind, purpose, attitude, education, social forces and heredity.

Titchener[2] says, "Intensity, quality, repetition, suddenness, movement, novelty, congruity with the present contents of consciousness, are one and all determinants of attention." Though he does not specifically separate his determinants into two groups, it is apparent that the first five, to adopt Pillsbury's terminology, are objective, and the last two, subjective conditions. Even though different terms are included in the lists of these two authors, there is agreement in presenting two different kinds of conditions or determinants.

Concerning the objective conditions, Pillsbury[3] says, "The effect seems to depend entirely upon the brute force of the stimulus and as little as may be upon the nature of the organism at the time."

Titchener[4] has the following to say concerning the determinants of attention which we have called objective: "It is worth noting that all the members of our list"—if it is true of all, it must be true of each—"are of a kind to produce a powerful effect upon the nervous system. Intensive stimuli naturally set up intensive nervous excitations; and intensive excitations will not be easily checked or obscured by rival excitations. The qualitative stimuli that compel attention appeal to some peculiar susceptibility of the nervous

[1] Pillsbury, 'Attention,' pp. 26–52.

[2] Titchener, 'Textbook of Psychology,' p. 270.

[3] Pillsbury, 'Attention,' p. 28.

[4] Titchener, 'Textbook of Psychology,' pp. 270–271.

XUM

system. Repeated stimuli have a cumulative influence. Sudden stimuli impinge upon nervous elements that have recently been free from stimulation of their particular kind, that is, upon elements of a high degree of excitability; and it is also probable that the excitations which they arouse suffer less dispersion and diffusion, within the nervous system, than those set up by the gradual application of stimulus. Moving stimuli affect different nervous elements in quick succession; there is no possibility of fatigue or of sensory adaptation; in a way, therefore, the action of the moving stimulus is cumulative."

These objective conditions are given names indicative of some peculiarity of the stimulus, a peculiarity which, either because of intensity in some form or because of the mode of affecting the sense organ, results in a greater massing of nerve energy in some cortical region than is supplied by other competitive stimuli. It is not denied that other factors, such as inertia of sense organ, may be involved, but these will be disregarded for two reasons: first, because they probably can also be reduced to intensity of cortical action; second, because the relevant point is the one already mentioned, namely, that such objective conditions are accompanied by greater activity of a given cortical region than is brought about by other stimuli.

Were the objective the only conditions of attention, consciousness would be a relatively simple affair, made up of pulses of immediate awareness. These would be comparatively simple, without past or future reference, meaningless in any conscious sense; in brief, successive and simple awarenesses of the passing show.

It is possible that successive elements may become associated, may even furnish materials for memory in animals possessing that function. Unless the incoming impression be connected with some other conscious element, however, it soon lapses from consciousness, to be supplanted by some other experience.

We find, then, that the objective conditions considered alone can give but the simplest form of experiences, unrelated,

XUM

without implication,—James's booming buzzing confusion. But they do offer a starting point for experience, a condition necessary for the very existence of consciousness if we accept the story of Strümpell's patient. No psychoses without neuroses is a generally admitted principle. Equally accepted is another,—there can be no neuroses unless physical stimuli affect the sense organs.

Turning now to the subjective conditions, we find that Titchener[1] has the following to say: "As for the effect of congruity with consciousness, it is clear that the more nearly an incoming excitation coincides with an excitation already in progress, the more easily it will make its way within the nervous system, and the more dominant it will become." "Any organism that has risen high enough in the scale of evolution to have a consciousness made up in part of ideas, of memories and imaginations, will be powerfully impressed by stimuli that are congruent with those ideas; it is precisely to such stimuli that the gates of the nervous system lie open."

Pillsbury[2] says, "Given any idea in mind and a corresponding impression offered to the senses, that impression will be preferred over the others."

This principle makes Pillsbury's 'idea in mind' and Titchener's 'congruity with consciousness' to all intents and purposes identical. We find, consequently, that attention is determined not only by intensity of nervous action in the cortex resulting immediately from physical peculiarity of stimulus, but also by the nature of the present contents of consciousness.

Pillsbury,[3] however, goes further than this. He says, "Not only do ideas that are actually present in consciousness at the moment have an influence in determining what impressions shall become conscious, but other experiences, which are much more remote in time and not in consciousness at the moment, also play a part." In this group he would include, with the exception of idea in mind, all of his sub-

[1] Titchener, 'Textbook of Psychology,' p. 271.
[2] Pillsbury, 'Attention,' p. 36.
[3] Pillsbury, 'Attention,' p. 36.

jective conditions, those depending upon habits of thought and those depending upon heredity. Their explanation must be a reference to the convenient formula, neural pathways of low resistance. There is, then, a third principle to be noted in explaining the conditions of attention, nervous pathways.

But let it be noted at this point that such pathways fall into two classes: first, those acquired by the individual during his life time as a result of his own unique experiences; second, those inherited from his ancestors. The former, by restimulation, may give rise to memories of previous experiences, thereby supplying ideas-in-mind; the latter, by stimulation, may give rise to movements and sensations, but certainly not, in their first appearance, to ideas-in-mind.

Analysis of the conditions of attention, then, shows them to be three-fold: physical or objective; physiological or nervous; mental or subjective. From what is overtly stated in the quotations given above, and from what may justifiably be implied from them, it may be concluded that attention is really a function of the region of the brain which is most active at any instant.

In other words, attention equals (strength of stimulus) *minus* (amount of nerve energy used up in crossing synapses) *plus* (amount of activity going on in the receptive region of the cortex).

The foregoing analysis also shows that attention is considered to be, not the awareness of the entering impression nor the awareness of the idea-in-mind, but the awareness of the two together. The entering impression, to linger at all in consciousness, must form a connection with what is already there, either actually or potentially. Such connections are furnished, first, by the present congruous contents of consciousness—a condition known under the various names of perception, recognition, cognition and meaning; second, by retained experiences not at the moment present in consciousness but liable to re-arousal, a condition which has been called apperception. In either case, personal individual experiences are necessary. Instincts in their first appearance

XUM

are inadequate for they result essentially in activity, thus possibly causing sequences of sensations, but certainly not immediate centrally aroused processes.

Our normal adult attention is essentially a relating activity, a bringing together of the incoming and what is already there. As we have already seen, the incoming is the direct result of a *vis a tergo* and so may be spoken of in a figurative way as a 'push from behind.' Similiarly, the present content of consciousness, in so far as it exerts a selective influence on the presented sensations, emphasizing one and rejecting others, may be said, again figuratively, to exert 'a pull from ahead.' Attention then results from an interplay of these two forces and is consequently not a simple elementary process, but complex. In that it consists of two mental processes, it is analogous to association. In fact, it would appear that instead of attention's being the unit of the association process, association is the unit of attention.

A word of qualification is necessary at this point. Associations may be divided into two classes, those which operate simultaneously or instantaneously and those which operate in succession. In the latter class would be included memories, delayed recognitions and the like. In the former would belong perceptions, immediate meanings, immediate recognitions and the like. Attention would, then, depend upon the former class of associations. The latter would result in successive pulses of attention. Attention is complex in the same sense that perception is; the fact that it is possible to attend to a percept proves this automatically. But memory images, on the other hand, are attended to in successive pulses.

Since attention is a complex resulting from a combination of the 'push from behind,' which initially is sensory, and the 'pull from ahead,' which is necessarily central, it is pertinent to ask whether the fact can be used to explain any of the peculiarities of attention and allied phenomena?

One topic concerning which there has been so much disagreement as practically to force it outside the realm of theoretical psychology is interest. The reviews of 'Atten-

tion and Interest' are long on attention and microscopically brief on interest. This is extremely unfortunate, for an understanding of the laws and principles of interest is of great importance, both practically and theoretically. The viewpoint expressed in the first part of this paper, that attention is essentially a complex process, offers a somewhat different angle from which to approach the problem.

The first thesis is: *Interest results only from the complex form of attention.*

Pillsbury, in his discussion, identifies interest with nonvoluntary attention, giving as conditions all of the subjective group, except social forces. He therefore tacitly admits that in interest there are the two processes, the incoming and memories, actual or potential. As has been stated previously, the first appearance of the instinct, for example, can be accompanied by no characteristic centrally aroused process and consequently the so-called native interests are impossible in the strict meaning of the term. With animals having memory, however, subsequent arousals of the instinctive tendencies may call up memories and hence may be interesting. Whether these shall be called native interests is merely a question of terminology. The essential point is that individual past experiences, existing either as present contents of consciousness or as associative tendencies, are essential for the appearance of interest.

Strictly speaking, the primary form of attention resulting from the 'push from behind' cannot be interesting, for it is a mere passive awareness without meaning, purpose or future reference. In reference to a similar point Dewey[1] says, "Without this ideal identification of one sensation with another, knowledge would be impossible, and psychical life would consist of a series of transitory and shifting sensations, no one of which would be recognized nor referred to an object."

It appears, then, that if there are two forms of attention, one of which from its very nature is uninteresting, interest, if it exists at all, must be a function of the other or complex form.

[1] Dewey, 'Psychology,' pp. 144–145.

XUM

Does it follow that interest is a function of all forms of complex attention? Not at all; the evidence goes to show that the complex form of attention sometimes is interesting and sometimes is not. This leads directly to the second point.

Second thesis: *Interest results only when the complex form of attention consists of a relatively old and of a relatively new process.*

The 'push from behind' and the 'pull from ahead' can be divided into the old and the new. Such classification must be understood to suggest a relative difference only, for the borderlines which separate the new from the old and the old from the new are too shifting to permit of any hard and fast division. An experiment performed by the writer[1] presents indirect evidence of the rate of progress from the new towards the old. The experiment was to determine whether a picture was more likely to be noticed the first, second, third or fourth time it was shown. The percentages are given in the table below:

Appearance Number	Percent of Times Seen
1	100.00
2	95.50
3	73.00
4	67.30

The figures indicate that with material of the sort used there was a rapid falling off in likelihood of being noticed after the second appearance. Possibly the question is akin to the problem as to when recognition ceases to be delayed and becomes immediate.

Another bit of evidence pointing to the fact that attention reaches out for the new is quoted by Pillsbury.[2] "In determining the part played by eye movement in the perception of depth, Helmholtz had occasion to make a number of experiments on the influence of successive illuminations of the field of vision by the electric spark. . . . At first only a very imperfect image of any part is received. With each succeeding spark a greater amount of detail is perceived, until a clear image of that region is obtained."

[1] Adams, 'Advertising and Its Mental Laws,' pp. 111–116.

[2] Pillsbury, 'Attention,' pp. 33–34.

Since sustained attention is impossible without interest, it follows that when attention, as in a psychological experiment, must be sustained the subject seeks the interesting. In Helmholtz's experiment this was obtained by the mental reaching out for the new.

A logical classification of the old and the new as related to the 'push from behind' and the 'pull from ahead' together with their psychological names is given in the following form.

Push	Pull	Psychological Name
old	old	recognition
new	old	meaning, cognition
old	new	originality
new	new	no name; probably no existence

Recognition, as a process, the relating of the old with the old, is believed by many to be pleasant, but the writer has yet to find an assertion that it is interesting. Yet meanings, cognitions, new ideas and new discoveries may be and are interesting.

One of the biggest psychological laboratories for testing in a practical way the psychological principles of attention, interest, desire, belief and volition, is found in advertising. A method made public by Kitson in 1921 and used by the writer since 1913 in the investigation of advertising problems, depends upon the assumption that advertising tendencies which are successful tend to persist, whereas those which are unsuccessful tend to disappear, the result of natural selection and survival. Since one of the necessities of successful advertising is the arousing of interest, it will be illustrative at least to compare the percentage of advertisements used now which give information, present the new, as compared with those of a decade ago. A study of this kind is reported by Kitson.[1] Analysis of 1000 advertisements contained in Collier's Weekly for 1902 showed that 22 percent were informative in character. A similar study of the same medium for 1919 revealed that 74 percent were informative. This increase of 52 percent in 17 years in information-giving advertisements is an illuminating illustration of the psycho-

[1] Kitson, 'The Mind of the Buyer,' p. 79.

logical principle involved if the increase has been at all constant and regular.

By experimental evidence it has been shown that interest may be present when the old and the new are brought together in consciousness. By accepted terminology it has been shown that when the old and the old are brought together interest is lacking. By exclusion, then, interest can appear only when the old and new are brought together in consciousness.

But is interest always experienced when the old and the new are brought together in consciousness? By no means. Other limitations are necessary, and the ones most immediately suggested concern further relations and peculiarities of the old and the new.

Third thesis: *Interest results only when there is congruence between the incoming and the present contents of consciousness, either actual or potential.*

This proposition divides immediately into two parts. The first condition exists when the idea in mind selects incoming impressions congruous with it. The second condition exists when the powerful entering experience finds nothing at the moment in consciousness congruous with it, and is forced for self-preservation to make central connections of a congruous sort.

Concerning the first form, little need be said. Pillsbury[1] in his discussion of the idea in mind as a subjective condition of attention cites a host of examples taken from the experimental literature and gives many every-day illustrations. To his data may be added the evidence derived from the complication experiment and certain practical evidence obtained from advertising. Walter Dill Scott,[2] in his investigations of the relative effectiveness of the segregated advertising section as compared with advertisements mixed with reading matter, found that, "Space next to reading matter is more valuable than space in the segregated advertising sections for advertisements of silk if the advertisement

[1] Pillsbury, 'Attention,' pp. 33–35.

[2] Scott, 'Advertising and Selling,' January, 1916.

is placed next to an article on dresses or interior household decorations; for advertisements of seeds, if placed next to an article on gardening, for advertisements of almost any class of goods if placed next to an article dealing with the use of the goods advertised." This certainly is an excellent illustration of congruence.

When the incoming impression, however, is more potent than the cortical set or predisposition and when there is also a lack of congruence, involuntary attention is the inevitable result. The process thus attended to either fades promptly from consciousness or must make contacts with congruous elements of past experience then lying dormant. This, when accomplished, is a condition of non-voluntary attention, but between the involuntary and the non-voluntary there is frequently, if not always, a period of voluntary attention. There is in this situation, therefore, no immediate interest; in fact the interest appears only when the incoming has become subordinated to the processes of central origin.

A further limitation of interest is given in the following thesis.

Fourth thesis: *Interest has a future reference or implication.*

It has already been pointed out that interest can appear only when the old and the new are brought together in consciousness. The only basis for anticipation, expectation and forward projection in time is found in some record of the past. Such data come most immediately from memory, and memories certainly are in our terminology old. When the old is joined with the old as in recognition, interest is lacking. Only as the old is used to interpret or give meaning to the new does the process become interesting. For a thing means not only what it is in an abstract sense, but more vitally what it can do; and what it can do is a potentiality, an implication of something to come.

An example is furnished in Münsterberg's investigation of monotony.[1] In his investigation he selected those tasks which appeared to be the most monotonous and then asked

[1] Münsterberg, 'Psychology and Industrial Efficiency,' p. 196.

the worker whether or not the task were interesting. The report of the woman who packed electric light bulbs is especially informing. For the past 12 years she had packed 13,000 lamps a day, a total of about 50,000,000. Yet, says Münsterberg, "She assured me that she found the work really interesting, and that she constantly felt an inner tension, thinking how many boxes *she would be able to fill* before the next pause."

Kitson, in the study previously mentioned, divided the kinds of information given by the advertisements into four classes and determined the percentage of each used in the two years compared. His results are appended in the table below.

	1902	1919	Gain or Loss
Uses	57	66	9
Process of manufacture	22	14	− 8
Personnel of firm	11	18	7
Sources of raw material	10	02	− 8

Information pointing to the future, that is, uses, holds the first place throughout. In 17 years it had gained in popularity as has also information about the personnel of the firm. It will be observed that the two categories, process of manufacture and sources of raw material, have fallen off in use. It will be further noticed that the emphasis with these two categories is upon the past tense. It will be furthermore noticed that the relative frequency with which these four categories are used varies directly with their future reference.

Illustrative of the same point is the investigation conducted by automobile companies concerning the strongest selling point for cars. It was found to be durability, concerning the future reference of which there can be no doubt.

But both past experiences and future references can be divided into those which are pleasant and those which are unpleasant. And concerning these a similar generalization can be made. In relating the old to the new we should give that sort of the old which has had on the average pleasing after-effects and may be expected to do so in the future. This

point is illustrated by the manufacturing concern which was ready to launch an intensive selling campaign of an article to keep the feet warm in cold weather. Since the article was intended for those who suffered from cold feet, it was naturally directed to them. To arrest their attention the following headline was used—COLD FEET. For some mysterious reason the article did not take. The advertisement was submitted to an expert for criticism. He decided, and rightly, that persons who suffered from cold feet were not interested in cold feet, but would be much interested in warm feet. So the headline was changed to read WARM FEET and the remainder of the advertisement was left untouched. Sales began to pick up immediately. Cold feet were a present condition, and to that extent both uninteresting and unpleasant. Warm feet were a future possibility and for that reason interesting.

On the reverse side, common observation tells us that when we may expect only a repetition of the same old thing, interest tends to lapse. The behavior of the spectators at any athletic contest is an illustration. When the game is a 'walk-over,' so that they may look simply for repetition of what has already been done, large numbers leave the contest before it is over. But when the game is close and anything is likely to happen, they tend more strongly to remain to the finish.

Closely allied to this topic is the next proposition.

Fifth thesis: *The interest attaches to the ends, not to the means to the ends.*

Rigid definition of terms is important in this connection. The term *end* will be used to mean the mental representation of some goal which is to be accomplished; *means* includes the physical or mental operations necessary to accomplish or realize the end. Obviously, then, the terms can be used only in a relative sense, for as mental attitude shifts, an end may become a means or a means an end. For example, I may desire to learn a new dance step. The learning is the end or goal. The means to the end consists in locating a dancing master, making an appointment. So much is old, is mere routine, is habit and is not interesting. But the trial and

error which follows, making the same old feet behave in a new way, introducing a new order into the same old movements, that is interesting. When the movements become automatic, interest in them lapses. The dance step becomes a means to a different end and interest attaches to the end.

But not all ends are equally interesting. Some of the influential factors have already been given; others remain to be considered.

Sixth thesis: *Interest tends to attach more strongly to the more immediate ends.*

This follows immediately from the very nature of attention itself, for it is impossible to keep long and consistently in mind the idea of any end. At best the remote end can manifest itself as an attitude or purpose, and there is good ground for believing that the present contents of consciousness is more effective as a selective agent than is cortical set alone. In most cases, in fact, it is possible to retain interest in a remote goal only by the interpolation of a series of more immediate ends.

If the words immediate and remote are used in a spatial as well as a temporal sense, examples are perhaps more obvious. Judging from the contents of their sheets, the newspaper editors believe that the fractured arm of a neighbor is as interesting as the slaughter of scores of persons on the other side of the globe. Doings remote in time or space are ordinarily of but little concern to us. As Pillsbury[1] says, "We find that we are interested in those things most closely related to our own past life. We are interested in the 'local' items of our own town paper, while similar items when read in the paper which we pick up on the table of a friend seem ludicrous in their puerility. A student is interested in anything that is new to him, but at the same time is so closely related to the things which he has known before that he has no difficulty in connecting it with some previous bit of knowledge. And the closer the connection, and the more important to the person the things with which it is connected, the stronger is the interest." This surely is but another way of stating our next thesis, which needs no further demonstration.

[1] Pillsbury, 'Attention,' p. 53.

Seventh thesis: *The center of interest is the self.*

Two other problems remain to be considered. The first is analogous to the old question, Is there sound where there is no ear to perceive it? Is the interest in the event or in the perceiving individual? Possibly the whole question as stated in this form is one of definition. What is meant is, Are there certain events or objects which tend to be universally interesting, or is interest entirely individualistic? It may be argued that since we have a common fund of experiences provided by way of instincts, etc., that situations calling out such expressions will be interesting. But the objection is that these common events become interesting only after experience and that then the interests become varied. It is the nature of the past experience and the demands of the present situation which determine interest.

Münsterberg's[1] researches on monotony have a direct bearing on the problem. It will be recalled that he found persons engaged in the most uniform and apparently monotonous tasks who took interest in them; whereas others whose work offered apparently the greatest possible variety found them to be monotonous and boresome. Speaking of a class-room experiment he says, "We found that in the whole student body there was a tendency to underestimate the number of the similar or of the repeated words. The majority of my students had a stronger impression from the varying objects than from those which were in a certain sense equal. Yet this tendency appeared in very different degrees and for about a fourth of the participants the opposite tendency prevailed. They received a stronger impression from the uniform ideas . . . . I found that just the ones who perceive the repetition least hate it most, and that those who have a strong perception of the uniform impressions and who overestimate their number are the ones who on the whole welcome repetition in life."

This quotation emphasizes not only the fact of individual differences in interest, but ascribes a reason for them, showing how they result from the inner constitution of the person.

[1] Münsterberg, 'Psychology and Industrial Efficiency,' pp. 195–205.

We are forced to agree with Pillsbury[1] that "Interest then is not dependent upon the object, but upon the nature of the man to whom the object is presented."

The remaining topic has to do with the relation between interest and affection. Some authors contend that interest is a feeling, a pleasant attention. If that is the way they define interest they are undoubtedly right, but they certainly are at variance with the ordinary meaning of the term. In its usual connotation, interest may be either pleasant or unpleasant. One may be interested in the football scores, he may be interested in the technique of a play or novel, he may be interested in the rise of his temperature, or in the operations of his dentist. And in some cases his interest will be pleasant and in others unpleasant. In so far as interest is related to anticipation, it would be incorrect to say that it is always pleasant. Interest may have the same degree and quality of affection as any other sensory or ideational material.

But since interest does point to the future and tends to lapse when the goal is attained, is anything left other than an awareness of the end? Apparently when the goal is reached and the interest lapses or shifts elsewhere, an afterglow either of pleasure or displeasure remains for a time. When the dance step is learned, the interest abates, but the pleasure increases; when the touchdown is scored the interest wanes, yet the pleasure is augmented.

Throughout the whole discussion it is necessary to distinguish between the interest and the pleasure. A succession of tones, listened to merely as a succession, without anticipation of what note is to come next, without interpretation, without reference, may be pleasant but not interesting. Similarly recognition is uninteresting but pleasant when the activity stops short with the recognition. The old, the past, is uninteresting in itself; the present is uninteresting; only the future is interesting.

In conclusion, it may be remarked that the pedagogical aspect of the problem is always with us. We are told—and

[1] Pillsbury, 'Attention,' p. 54.

truly—that students will not learn if they are not interested and are led to believe that if the interest is supplied they will learn. Can the general theory outlined in this paper be brought to bear upon this practical problem? It has been pointed out that interest appears only when there is a relating of the old with the new. It has also been indicated that the condition most favorable for interest occurs when the old 'pull from ahead' is more potent than the new 'push from behind,' for then the present contents of consciousness selects in a purely non-voluntary way. The essential thing is the setting up of a mental goal, one which is not too remote. Are we too prone in writing our text-books and in giving our lectures to depend upon the strength of the incoming novelty, be it vaudeville, shouting, enthusiasm, calm repetition, anecdotes, or what-not, to attract an artificial interest to the topic? If interest does develop in this situation, it is, as has already been shown, a result of voluntary attention on the part of the student. The incoming novel ideas may tie up with some part of his mental equipment but bringing the two together is largely a random activity. Would it not be better, by first providing a goal, to develop a method whereby the student could bring to bear, as a result of the natural selective action of mind, what he already knows? This method would certainly lead to a more careful selection and exclusion of material and would be better fitted to induce real mental activity on his part. It is the belief of the writer that giving the student a goal at the very outset would render *possible* the necessary mental coöperation.

XUM

THEORIES OF TEMPERAMENT: AN ATTEMPT AT RECONCILIATION

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There is at the present time no satisfactory definition of temperament and no generally accepted analysis of its constituent factors. Any discussion of temperament usually involves questions of character and personality; but the interrelationship of these three traits is undefined and ambiguous. That temperament is a matter of the emotional characteristics of the individual, and that it is an aspect of the personality coördinate with intelligence and character probably sum up all that will be generally acknowledged. In this paper no attempt is made to keep the concepts of character and personality out of the discussion; and no doubt much that is said may be construed as applying to aspects of the individual not usually covered by the term temperament. The traits under consideration are, however, for the most part of the affective class, and the problem is therefore chiefly one of temperament, as the term is here used.

A distinction is sometimes made between disposition and temperament. The former is regarded as a matter of emotional or instinctive attitude, probably based upon the native prescription of instincts; while the latter is a matter of general hedonic characteristic, based upon bodily conditions, such as endocrinal factors and the nature of the nervous tissue: excitability, fatigability, and so forth.[1] This distinction has some historical justification and it may have some value; but in this paper the term temperament signifies *total affective make-up*. It thus includes the factors designated by the term disposition. This is more in agreement with popular usage, and conforms as well to the more frequent usage in psychopathology. Furthermore the results of recent investi-

[1] See for example Warren, H. C., 'Human Psychology,' pp. 365 and 375, also McDougall, Wm., 'Introduction to Social Psychology,' p. 117.

gations tend to break down the distinction; for disposition as defined is referable through instinct to bodily conditions probably of the same kind as those concerned in temperament. The limitation of the term temperament to speed and strength of reaction, as in the Wundtian analysis of the traditional temperaments seems wholly arbitrary, for speed and strength are merely aspects of the total affective pattern.

The essential nature of temperament is, if possible, more uncertain than its definition or its analysis. There are in the field many apparently divergent theories. It is the object of this paper to present these theories, to raise the question of their ultimate harmony, and to indicate certain factors that must be taken into consideration in any final theory of temperament. The topics that will be discussed in succession are as follows: (*a*) relation of temperament to instinct, (*b*) relation to internal secretion, (*c*) relation to autonomic functions, (*d*) psychopathic types of temperament, (*e*) inheritance of temperament.

(*a*) The relation of temperament to instinct is perhaps the most obvious aspect of the subject. There appears to be a temperament (disposition) based upon each of the most important instincts. Fear has its temperamental parallel in timidity, pugnacity in irascibility, self-assertion and self-abasement in ascendency and submissiveness, the parental instinct in tenderness (altruism), love in amorousness or sentimentality, acquisition in miserliness, the gregarious instinct in sociality, and so on. Subjects differ in temperament because they do not inherit all the instincts to the same degree. Temperament is due to the predominance of some one instinctive tendency or to the greater susceptibility to some one particular type of instinctive response. If two or more dominant instincts are about equal in strength, the resulting temperament will be in the nature of a compromise or combination. Aggressiveness, for example, is probably a matter of self-assertion and pugnacity. This dependence of temperament upon instinct does not imply any particular theory of the emotions. Whether emotion

XUM

is itself a kind of instinct, or the visceral aspect of an instinct, or the subjective aspect of an instinct does not matter in this case. Such questions arise only when the fundamental nature of temperament is involved.

A special form of dependence of temperament upon instinct has been emphasized by the psychoanalysts, especially by Adler[1] and his followers. They have pointed out that frequently a trait of temperament or character may be a compensation for or a defense reaction against a strong instinctive trend of an opposite nature. Pronounced egotism is thus a defense against a strong feeling of inferiority, prudishness is a defense against unusual eroticism, and so on. It would seem, therefore, that the dominant instinct may result in either a similar temperament or an opposing one depending perhaps on the nature of one's early training. In the former case the temperament is truly instinctive, in the latter it is rather a matter of habit. Instinct is concealed by compensating habits. Some of the possibilities are indicated in the following table.

Instinct	Similar Temperament	Compensating Temperament
Fear	Timidity	Courage (rashness)
Curiosity	Progressiveness	Conservatism
Pugnacity	Contentiousness (irascibility)	Pacifism
Self-assertion	Ascendency	Submissiveness
Self-abasement	Submissiveness	Ascendency (egotism)
Parental	Tenderness (altruism)	Misanthropy
Love	Amorousness (sentimentality)	Prudishness
Acquisition	Miserliness	Prodigality
Gregariousness	Sociality	Antisociality

It should be noted that in certain cases a temperament is capable of a two-fold interpretation. It may be due to a dominating instinct, or to a compensation for an opposite instinct. Egotism (ascendency), for example, may be based upon self-assertion or may be a compensaton for self-abasement (inferiority), courage may be based directly upon pugnacity and self-assertion or may be a reaction against fear, pacifism may be based upon fear or upon repressed pugnacity,

[1] A. Adler, 'The Neurotic Constitution,' tr. by Gluck and Lind. Moffat, Yard & Co., 1917.

and so on. In such cases the instinctive temperament may be distinguished from the one due to compensating habit by the fact that the latter usually goes to extremes. A courage that compensates for fear is usually rashness, an egotism that compensates for inferiority is more or less megalomaniacal, and a pacifism that compensates for pugnacity is a militant pacifism. A compensating temperament is never a golden mean. Its very existence depends upon a complete denial of the opposite trend. Prudes are always extremists.

(*b*) The endocrinological theory of temperament is a more recent development. It may, however, be regarded as a modern form of the four-humor doctrine of the ancients, which has been handed down through twenty centuries and which still influences psychological terminology. Many modern textbooks classify temperaments after Galen into sanguine, phlegmatic, choleric, and melancholic. The modern theory ascribes temperament to the influence of autacoids (hormones and chalones) thrown into the blood stream by ductless glands. The type of temperament depends upon the dominating gland—a matter of relative hypersecretion. We thus have a temperament for each endocrine gland instead of for each instinct as above. For example, the thyroid temperament is the restless, excitable, nervous type; the adrenal temperament is the virile, aggressive, pugnacious type; and characterizations of other gland types have also been suggested. Furthermore, anything which temporarily upsets the normal endocrinal balance will lead to moods or temporary aberrations of temperament.

This theory arose from the work of Cannon,[1] and Crile[2] on internal secretion in the emotions; and has been applied to personality and temperament by Lavastine,[3] Berman,[4] and others. It is probably not incompatible with the first

[1] W. B. Cannon, 'Bodily Changes in Pain, Hunger, Fear and Rage.' Appleton, 1920.

[2] S. W. Crile, 'Man an Adaptive Mechanism,' Macmillan, 1916.

[3] M. Laignel-Lavastine, 'The Internal Secretions and the Nervous System, Nervous and Mental Disease Monog., No. 30, 1919.

[4] L. Berman, 'The Glands Regulating Personality,' Macmillan, 1921.

theory, but merely carries the analysis one step further. The dominance of an instinct may be based upon the relative dominance of some endocrinal gland; and a compensating temperament would thus be interpreted as a strong system of habits built up to overcome and conceal the ever present influence of the dominating gland.

(*c*) The relation of temperament to autonomic functions has been worked out chiefly by Kempf.[1] The autonomic nervous system consists of two antagonistically related parts: (1) the sympathetic system and (2) the cranial and sacral systems. The smooth muscles and glands constitute part of the total autonomic apparatus, and they are supplied for the most part by nerves from each of the above systems. For example, the cranial system is inhibitory to the heart and excitatory to the stomach, whereas the sympathetic is excitatory to the heart and inhibitory to the stomach. At every segment this antagonism between the two systems occurs, and there is a tendency to approximate what may be called a normal balance. When this balance is upset by either a hypertonicity of one system or a hypotonicity of the other, a 'segmental craving' arises. Furthermore, any variation in the physiological condition of a viscus due to such processes as assimilation and excretion also results in this segmental craving. An empty stomach, for example, results in rhythmic tonic contractions of the stomach walls and consequent craving in the gastric segment (hunger). Such autonomic affective disturbances compel the projicient apparatus (central nervous system), which is an instrument of the autonomic, to continually adjust its receptors until stimuli are found which allay the distress. These segmental cravings or ego-centric drives vary from subject to subject and are the very foundation of personality. Temperament is thus determined by the unbalanced segment or the most easily unbalanced segment, and by the habits (conditioned behavior) acquired by the central nervous system in order to relieve the segmental distress.

[1] E. J. Kempf, 'The Autonomic Functions and the Personality,' Nervous and Mental Disease Monog., No. 28, 1918. Also 'Psychopathology,' C. V. Mosby Co., 1920.

Is this theory compatible with the endocrinological and the instinct theories? Since glands of internal secretion are merely a part of the total autonomic apparatus, it is clear that endocrinal functions are included in autonomic functions; and, moreover, it has been shown that the hormone action of adrenalin, upon the circulation for example, is the same as excitation of the sympathetic system which supplies the segments concerned. Where the sympathetic excites, adrenin excites; where the sympathetic inhibits, adrenin inhibits. Similarly every internal secretion may have the same effect as some segment of the autonomic system. Internal secretions and autonomic functions are thus mutually interdependent. A segmental distress may be initiated by hypersecretion, and vice versa a hypersecretion may be initiated by a segmental distress. It is clear that we have here two complementary functions neither of which can at present be regarded as more fundamental than the other; and just as instinct may be a matter of relative hypersecretion so it may be a matter of the tonus of autonomic segments. Thus the three views so far considered are on analysis found to be in reality harmonious, or at any rate not incompatible.

(*d*) Psychiatrists have frequently called attention to the exaggerated forms of temperament found in the psychopathic and insane and their relation to certain normal types. Here as elsewhere a study of the abnormal has thrown light on normal traits often overlooked, because the abnormal present the same phenomena in relief. Jelliffe[1] has called our attention to the cyclothymic temperament which is exaggerated in manic-depressive insanity. Its main characteristic is the alternation of exalted and gloomy moods. In some cases the exalted or euphoric mood tends to predominate, while in others the gloomy mood plays this rôle, just as in manic-depressive insanity there may be regular alternation or the tendency for one mood to predominate. Hoch[2]

[1] S. E. Jelliffe, 'Cyclothymia—The Mild Forms of Manic-Depressive Psychoses and the Manic-Depressive Constitution,' Nervous and Mental Disease Monog., No. 9, 193–208, 1912.

[2] A. Hoch, 'Constitutional Factors in the Dementia Precox Group,' Nervous and Mental Disease Monog., No. 9, 111–122, 1912.

and Jung[1] have studied the autistic or 'shut-in' temperament in dementia precox, and have compared it to the introverted, day-dreaming type among the so-called normal. The hysteric temperament with its emotional instability and superficiality has been described by Ribot[2] as 'psychological infantilism' which is shown in varying degrees by many people not usually classified as hysterical. The epileptic temperament with its egoism, ill-humor, fanaticism, obstinacy, and duplicity is referred to in every treatise on the subject. Surely many non-epileptics show the same traits in lesser degree.

Rosanoff[3] has recently presented a theory of personality based on psychiatric experience. He classifies the abnormal types into (*a*) the antisocial, the hysterical, malingering, criminal type, (*b*) the cyclothymic, (*c*) the autistic, and (*d*) the epileptic. These types are merely quantitative variations of normal types. No hard and fast lines can be drawn between the types. Pure types are the exception, mixed types the rule in both normal and abnormal cases. All normal subjects have within them either manifest or latent antisocial, cyclothymic, autistic, and epileptic tendencies in various degrees. These tendencies may be observed especially in children; but they are normally inhibited to some extent and outgrown in the course of development to maturity. The power of inhibition is thus the most important differentium of the so-called normal.

(*e*) These temperamental trends are, according to Rosanoff, inherited in accordance with definite Mendelian principles and in conformity to the following scale of dominance: normal, antisocial, cyclothymic, autistic, and epileptic. The scale progresses from epistatic to hypostatic traits, that is to say, the manifestation of each succeeding trait is concealed or inhibited by the preceding one. A general power of inhibition may also be inherited. Davenport[4] has shown

[1] C. G. Jung, 'Analytical Psychology,' Chap. XI. Bailliere, Tindall & Co., 1920.

[2] Th. Ribot, 'The Psychology of the Emotions,' Chap. XIII. Ch. Scribner's Sons.

[3] A. J. Rosanoff, 'A Theory of Personality Based Mainly on Psychiatric Experience,' *Psychol. Bull.*, 1920, **17**, 281–299.

[4] C. B. Davenport, 'The Feebly Inhibited: Violent Temper and Its Inheritance,' *J. Nerv. & Ment. Dis.*, 1915, **42**, 593–628.

that feeble inhibition is probably a Mendelian dominant in inheritance. When the inhibiting power is weak or when it is removed by drugs, by disease, or by senile involution, the underlying trends come to the surface.

Davenport's[1] genetic studies have led him to the hypothesis that temperament is determined by two germinal factors: (1) an exciting factor, *E*, and its absence, *e*; and (2) a factor for cheerfulness, *C*, and its absence, *c*. These factors behave as if in different chromosomes, so that they are inherited independently of each other and may occur in any combination. Nine different zygotic combinations are possible; and, since dominance is imperfect, two doses of a factor giving a more pronounced result than one, nine different types of temperament may arise. This genetic account needs to be supplemented by psychological analysis before its validity can be finally established. In this connection the value of coöperation between genetics and psychology in the determination of the fundamental factors in human nature cannot be too strongly emphasized.

Concluding Remarks.—The study of pathological cases has given us a description and classification of temperaments which are manifested to a lesser degree in the normal or which are normally overlaid by inhibiting factors. These temperaments may be based upon instincts, upon endocrinological factors, upon autonomic functions, or upon all three, as has already been indicated. An overdevelopment of the inhibiting factor here mentioned would result in a so-called compensating temperament. The pathology of temperament thus becomes the pathology of internal secretion or of autonomic function, and in the same way the inheritance of temperament is the inheritance of endocrinal and autonomic relationships. Whether temperament can be reduced to the simple factors in Davenport's analysis, and, if so, what this means in purely physiological terms, are questions of detail that may be answered in time.

The relationship of Rosanoff's pathological types to

[1] C. B. Davenport, 'The Feebly Inhibited: Nomadism, Inheritance of Temperament,' Carnegie Institution of Washington, publ. No. 236, 1915. Also, 'Heredity of Constitutional Mental Disorders,' *Psychol. Bull.*, 1920, 17, 300–310.

specific instincts is also not at all clear. Each type is probably based upon a number of instincts and may include in addition some compensating trends. In this connection it should be remembered that no attempt has been made to give a complete list of instincts. A few only have been mentioned by way of illustration. Some tendencies not usually found even in the most complete classifications should perhaps be given a place. Among these the regressive tendency may be mentioned. This is fundamentally a desire for the familiar, a fear of the new, a 'safety motive.' Its antithesis is the progressive tendency. These two trends may be reducible to fear and curiosity, or they may be quite distinct factors. They are mentioned especially because of the rôle they play in the so-called autistic or introverted temperament.

It has thus been shown in a very general way without consideration of the finer details that the various theories of temperament are fundamentally harmonious and merely emphasize different aspects of an exceedingly large and difficult topic. Whether they may all be reduced to one theory, and, if so, what the final theory may be are questions that cannot readily be answered. One point, however, should be emphasized, namely, that any attempt to develop a theory of temperament must take into consideration the following aspects of the subject: the relation of temperament to instinct, compensating temperaments, endocrinological factors, autonomic functions, pathological manifestations, and inheritance.

The present indications are, perhaps, that temperament is at bottom a matter of autonomic segmental cravings and their relationship, and of the original and conditioned responses of the projicient apparatus in order to relieve these cravings or tensions. Internal secretion is thus subsidiary to autonomic function, instincts may be interpreted as segmental tensions and compensations as conditioned responses to these tensions, and the pathology and inheritance of temperament become the pathology and inheritance of autonomic conditions.

THE ORIGIN OF LAUGHTER

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He who approaches *laughter* upon science bent will find it no laughing matter. Like many another trait in human nature its explanation has been a veritable *ignis fatuus*. "What does laughter mean? What is the basal element in the laughable? What common ground can we find between the grimace of a merry-andrew, a play upon words, an equivocal situation in a burlesque, and a scene of high comedy? What method of distillation will yield us invariably the same essence from which so many different products borrow either their obtrusive odor or their delicate perfume? The greatest of thinkers, from Aristotle downwards, have tackled this little problem, which has a knack of baffling every effort, of slipping away and escaping only to bob up again, a pert challenge flung at philosophic speculation."[1]

Bergson's method of distillation yielded a very remarkable essence of laughter; it is merely something mechanical in the place where we should expect flexibility and adaptability. It is the "image of *some rigidity or other* applied to the mobility of life, in an awkward attempt to follow its lines and counterfeit its suppleness."[2] We think of the spontaneous laughter of little children whose habits of perception do not permit the refinements M. Bergson describes, and at once his attractive and ingenious system topples over. Indeed, it is the laughter of the healthy youngster whose merriment is touched off by nothing more recondite than the sight of a chum, the yowl of a cat, or the idea of a holiday, which puts to rout the elaborate efforts of the savants. Said Hobbes: "Sudden glory is the passion which maketh those grimaces called laughter; and is caused by some act of their own that pleaseth them, or by the apprehension of some deformed thing

[1] H. Bergson, 'Laughter, An Essay on the Meaning of the Comic,' p. 1.

[2] *Op. cit.*, p. 38.

in another by comparison whereof they suddenly applaud themselves."[1] Said Kant: "Laughter is an affection arising from the sudden transformation of a strained expectation into nothing."[2] These oft-quoted analyses do show why some men laugh sometimes but they are useless in explaining the hilarity of a boy with a new toy.

Of course, the speculations of philosophy have done a great deal to throw light upon the various and curious causes of laughter. The philosopher, however, usually seeks to fit his interpretations into his system of philosophy. Unfortunately, the part is sometimes distorted when it is fitted into the whole.

On the other hand, science seeks first of all a description of the phenomenon, then a careful comparison with similar phenomena. Points of likeness must be indicated. The phenomenon must be classified and its explanation sought by reference to similar phenomena. If it fits with other findings it becomes intelligible; if not, it bides its time until a body of knowledge is built up into which it may be fitted.

Darwin made the first notable efforts to describe laughter.[3] He described the facial muscles and showed how characteristic expressions were obtained by their action, though he found it 'an obscure point why the corners of the mouth are retracted and the upper lip raised during ordinary laughter.' He also found it difficult to understand the peculiar sounds of laughter. "But why the sounds a man utters when he is pleased have the peculiar reiterated character of laughter we do not know. Nevertheless we can see that they would naturally be as different as possible from the screams or cries of distress; and as in the production of the latter, the expirations are prolonged and continuous, with the inspirations short and interrupted, so it might perhaps have been expected with the sounds uttered from joy, that the expirations would have been short and broken with the inspirations prolonged; and this is the case.[4]

[1] 'Leviathan,' Pt. I., Chap. VI.
[2] 'Kritik of Judgment,' translated by J. H. Bernard, p. 223.
[3] Charles Darwin, 'The Expression of the Emotions in Man and Animals.'
[4] *Op cit.*, p. 205.

Of course in weeping we have very much the same expirations and inspirations as in laughter. Often it is difficult to tell by the mere sound whether a person at a distance is laughing or weeping. This similarity Darwin does not point out. He does elaborate the similarity of laughing and weeping in the production of tears by the pressure of the muscles around the eyes.[1]

Laughter due to tickling Darwin considered a reflex action. A comparison with other reflexes shows it cannot be considered a reflex action. A stranger who does not tickle a child in a usual and a playful way does not evoke a laugh. No *reflex* behaves in such an eclectic manner. Moreover the same sort of childish laughter may be produced in many other ways. It would appear, however, that laughter has a very simple physiological basis, even though it is not a reflex. Darwin accepted Spencer's view that when one is in a 'pleasurable state of mind' any little event may cause an escape of nervous energy which takes the form of laughter. It is to be found in infants, in idiots and imbeciles, who laugh in a quite senseless way. Laura Bridgman, who had no opportunity to acquire any expressions through imitation, 'laughed and clapped her hands and the color mounted to her cheeks.'[2]

Laughter is certainly an instinctive act. In its simplest forms, as among children, it is an expression of a pleasurable state of being. It accompanies good health and a feeling of well-being. It may be aroused by no appeal to the intellect whatever. Such laughter is more physiological than psychological. It is an expression of contentment and satisfaction. Weeping is an analogue. In infancy it is an expression of discomfort or dissatisfaction. That these two processes are closely allied is apparent to anyone who studies cases of manic-depressive insanity. At one time the patient is alert, energetic, very talkative and laughs in high spirits; at another time he is very lethargic, inert, silent and is often so melancholy that he may constantly weep. Why these

[1] *Op. cit.*, pp. 162–174.
[2] *Op. cit.*, pp. 196, 197.

swings from the heights of hilarity to the depths of depression occur is not known. They are probably related to conditions in the endocrine system. Some forms of neurasthenia and Graves' disease give a nervous instability which easily results in either laughter or weeping. Hysteria is famous for the bewildering way in which laughter and crying intermingle. On the mechanical side, therefore, we find a physiological arrangement by which the pleasurable states and the unpleasurable are accompanied by a definite set of motor activities. There are few activities of a more clearly instinctive type than these.

Like other instinctive acts they are unlearned and occur spontaneously at an early age. By the third or fourth month the average infant produces the unmistakable evidences of laughter. His technique in screaming has been perfected long before this. It is hard to see what possible value the cooing, gurgling and faint laughing can be to the infant. They certainly do not guide the parental hand as does the cry of hunger, pain, fear or anger. Nor are they differentiated as are the cries of distress. No obvious purpose is served by the laugh in early infancy. It must be there because of a later value, as are the beginnings of other instinctive traits.

The first hours of existence, with the flood of new sensations, are filled with cries which are undifferentiated. After a few months a good nurse detects a difference in the cry of pain and that of ill-humor. As the infant matures, his crying is incited more and more by his emotions as they develop. Precisely the same is true of laughter. From an expression of physical well-being it becomes an expression of the emotions. At first laughter means only a comfortable little body. Then it means the pleasure from receiving sensations that develop the nervous system. Sounds which distress the adult delight the child. Motions, such as swinging, whirling on one heel, rising and falling on a 'see-saw,' all stimulate the organs of balance. They are delightful to children only. Running, jumping, all activities which aid the growing muscles are accompanied with hearty laughter in the healthy child. Physical well-being and all that makes

for physical well-being are the 'basal elements in the laughable' during childhood.

Very subtly other features of laughter appear. The instinct of self-assertion engenders laughter.[1] The little one who succeeds in gratifying this propensity laughs. There is a feeling of well-being in the satisfaction of the instinct which easily goes over into the 'pleasurable state of mind' that produces laughter. Play is an instinctive trait in all children. It implies a mood which is characteristic and which everyone recognizes but which is difficult to describe. It must, however, be a relatively simple state of consciousness, for it is apparent in a great many animals. So bound up in play and the spirit of play are the greatest causes of laughter that we find Sully, Sidis and Eastman all tracing many forms of natural laughter there.[2]

Gregarious tendencies early show their traits in children. Mere companionship seems sufficient to keep many children in a mood that easily bubbles over into laughter. Later in life the sex instincts are accompanied by pleasures in many disguises. It hardly seems necessary to subscribe to Freud's ingenious, involved and labored explanations of 'Wit and the Unconscious' to understand the laughter that greets the *risqué* joke. Quite as evident is the laughter which bespeaks the rich, deep emotions of the parent. So delightful are the accompanying emotions of the parental instincts that they well up and overflow in bursts of laughter upon the least provocation. A chubby fist, a miniature sneeze, a hiccough—and the sanest of parents laugh more at that bit of their own flesh and blood than ever they laughed at Falstaff.

On the other hand the instincts which are accompanied by unpleasent emotions, and by deleterious physiological conditions, easily give rise to weeping. Anger and fear are often accompanied by crying. Less conspicuous instinctive traits such as envy, jealousy, shyness and pity are all of a kind that we do not wish to continue, they cause discomfort. In

[1] W. McDougall, 'Social Psychology,' p. 66.

[2] J. Sully, 'An Essay on Laughter,' p. 145; B. Sidis, 'The Psychology of Laughter,' p. 3; M. Eastman, 'The Sense of Humor,' p. 226.

children, neurasthenics and in some women they readily cause weeping.

In short, the instincts act in exactly the same way as the simpler processes of nutrition and growth. They touch off the same physiological processes which emerge in a cry or a laugh. The principles underlying these activities are familiar. Every incoming nerve current tends to go out into some form of activity, either in gland or muscle. Both laughter and crying form a sort of final common path for such activities. This, however, does not explain why these particular forms of expression occur. We shall discuss that later.

Certainly the pleasures which grow out of the sensations, activities and instincts cannot account for all forms of laughter. They have no part in the laughter of derision, for example, or the laughter of embarrassment. Such laughter is an artifice. It is allied to language. It is not a natural outcome of a pleasurable experience. It is rather a means of conveying an idea, a form of statement. Though a laugh is as instinctive as a cough or a cry, it can be simulated as well as they. When an auctioneer laughs at the first bid he gets it is no expression of mirth, it is a statement to the crowd to bid higher. When a golfer misses the ball his laugh (if he does laugh) is an appeal to his audience. *It does not express pleasure.* Nothing is more serviceable than a laugh, in many of the exigencies of society. Many an argument finds its full answer in a guffaw, many a refusal is tempered by a kindly chuckle. Laughter of this sort is but a form of language.

It is not easy to say where spontaneous laughter ends and controlled laughter begins. Very little children will laugh as they report a misdeed in the hope that their mirth may become contagious and their punishment be thus mitigated. Laughter is 'good form' under many circumstances. Many an inadvertence is smoothed over by a friendly laugh. A friend who painstakingly tells a venerable joke should always be compensated in this way. Polite society is a connoisseur in these matters. People utterly innocent of any sense of humor are frequently quite expert in timely smiles or laughs.

However, among different nations in different ages various standards have grown up. Often loud, hearty laughter is frowned upon. No less authorities than Cicero and Lord Chesterfield are agreed it is identified with stupidity or childishness. In our own age and country there is a similar attitude toward boisterous laughter, at least in mixed company. Laughter passes from the spontaneous outbursts of childhood to a more controlled form of expression, and it is voluntarily used in many various circumstances.

Naturally we should expect it to conform to the idiosyncrasies of different races and nations as do language, manners and habits of thought. This it does in large measure, though like art there are fundamental principles in the humor of all peoples. Everyone has noticed the difference between Hibernian and African humor. It becomes a problem worthy of Kant to point out the basal elements in different types of national wit.

With maturity comes not only a control and some artificial direction of laughter, but an intellectual element, which gives quite a different aspect to the problem. Anyone who has given many mental tests to children of different ages must be impressed by the development of the sense of humor. How helpless the younger children are with the 'absurdities'! How quickly the older and brighter children see through them! They give an excellent diagnosis of mental development. However, the laughter that greets them is not an index of mental ability. Some children catch the points involved and explain the absurdity with no trace of a smile. Others break into a laugh as soon as they find the idea involved. Evidently a certain mood, or temperament, must accompany the alert mind to give rise to mirth. This we see in many people. Some very adroit makers of puns, repartee and jokes do their work in cold blood, and many a lover of fun is woefully lacking in wit. Only when we find the alert mind and the genial temperament do we encounter the complete humorist.

What are the intellectual factors that go into humor? That is just the question Bergson finds so slippery. The present article is not concerned with so difficult an analysis.

It is enough to concede that there are juxtapositions of ideas which give pleasure. There is both a science and an art in such arrangements. Some of these arrangements we call witty and some we call humorous.

Our present concern is with the *origin* of laughter. When and how did it become a trait in human nature? Surely it had a survival value or it would never have persisted through the ages. It is distinctly an instinct, for it occurs in the deaf and blind who could not have acquired it by imitation, and it appears in infancy in company with other instincts. Were it of little value it would have persisted in some simple vestigial form, but it is a vigorous, active factor in human life! Any attempt to explain its origin and development must recognize it as an *indispensable* adjunct to the human race at some time in its evolution. Few facts are at our disposal for the shaping of an adequate theory, but they serve at least as a general guide.

The Primates, such as the chimpanzee, the orang and several forms of Cebus monkey give clear evidence of the ability to produce sounds similar to laughter. We might assume that the instinct had its beginnings before the human species branched off from the common stock of the Primates, but this does not aid us in finding a survival value, for in many of the Primates laughter has not been noted at all and in those types where it has been observed it does not seem to be of any great importance. However, we may confidently state that it was well developed long before the different races of man diverged from their common ancestry, for it is found in all races. Between these two limits, then, laughter found its development, such that man has been described as the 'laughing animal.' Truly this is not a definite date! Perhaps we might take a step further and argue from the time of its appearance in infancy, that laughter preceded language by a great period of time in the evolution of man. At all events we are safe in assuming that the creature which developed language had great needs of communication and that in the remote past man found the instinctive vocalization of laughter indispensable.

More certain are the following guides. As man became more intelligent the period of infancy lengthened. Unlike other animals he did not bring forth his young in the spring and leave them to get their own living after caring for them through the summer and winter. His care had to extend through several years. Moreover, only one or two young were brought forth each year and the child-bearing age of the female extended over a long period of years. This resulted in a family ranging over many years,—a unique situation in the animal world. Like many other animals with young to care for during a long period, the male must have assisted the female in her efforts; and unquestionably both parents had to forage far and long to supply the needs of such broods. During such periods the older members of the offspring must have given some care to the younger. In these primitive conditions of life, when no language was available to express pleasure and displeasure, weeping and laughter were the primary signals for telling of physical conditions, moods and emotions. They conveyed the idea of discomfort and an appeal for assistance as well as the idea of well-being and a desire to have it continued.

A striking psychological feature should be noted in this connection. An injured child will naturally begin to cry. If its injuries are not very painful it will cease when it discovers that no one heeds its crying. Let anyone be present who might give succor or sympathy and its wails are louder and longer. Often a young child will receive an injury to its body, or its dignity, and utter no sound until it sees a source of sympathy in the distance; then its pent-up feelings make the air resound. So natural and spontaneous does this trait appear that it would seem to be a part of the instinctive nature of crying for aid rather than a result of deliberation and self-control on the part of the infant. Laughter has an even greater social feature in its psychology. One rarely sees a young child, quite alone, laughing in its play. If two or three are together the neighborhood may ring with their laughing. One of the very common observations of adults is the futility of a laugh when others do not hear it. One may

smile in isolation, but a laugh is short-lived. Nothing is more contagious than laughter. A matter which affords sufficient amusement for a laugh in isolation will bring a long and hearty succession of them if they are caught up and echoed by a number of other people. These simple expressions of displeasure and pleasure, therefore, are distinctly social.

In the primitive family, these forms of vocalization had a highly important place. They informed the parents of the state of affairs among their young. They apprised the older offspring of the condition of the younger. The little specimen of *Pithecanthropus Erectus* instinctively felt that its cry was an appeal for sympathy. Though the hands that brought it succor were the rough and hairy ones of parents, or older brothers, it was confident that they would be gentle and would bring its discomfort to an end. When it barked forth its delight with a certain situation it had a conviction that its laughter would help to continue the pleasant conditions that it was enjoying. As it entered into play, which characterizes so many species of animals, its weeping always meant an unwillingness to continue, while its laughter meant coöperation and a desire to continue. As it followed its associates it quickly learned what thickets were thorny and which fruits were good and a thousand other things by this simple language of the feelings.

All things that were good, that made for pleasurable feelings were greeted with the full-throated, deep-chested laughter that springs forth naturally. A find of good food, a fortunate shelter, a refreshing spring, meant the resounding roar of laughter! No man, modern or primitive, laughed merely to hear himself laugh. These early cries of pleasure were calls, invitations to others to share the delightful mood. He who lacked this mood was no fellow man; he was a pariah. If he gave no signal of the good fortune which was his, he had no place among the 'laughing animals.' He should have been exterminated. He undoubtedly was. From his earliest cries of pleasure that brought him his share of the play among his brothers, to his great calls in the forest as he

stood over his slain quarry, laughter meant the mood that shares with others.

No nobler tribute was ever paid a living creature than that of 'laughing animal'.

If this explanation of the origin of human laughter is correct we may, with great satisfaction, abandon those attempts which sought its origin in the suffering of others. Said George Eliot, "Strange as the genealogy may seem, the original parentage of that wonderful and delicious mixture of fun, fancy, philosophy and feeling which constitutes modern humor, was probably the cruel mockery of a savage at the writhings of his enemy."[1] It is a long descent of man from the great-hearted laugh of the primitive creature calling others to share his joy to the laugh of Thomas Hobbes when he compared his good fortune with the misfortune of others. Man cannot descend much further than that.

[1] Quoted by Sully, *op. cit.*, p. 229.

A THEORY OF COLOR VISION

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The purpose of this article is to set forth a theory of color vision which was derived from that of Hering, by making changes of small *psychological* importance, and which was then found, except in details of little *physical* significance, to show a surprising resemblance to the Young-Helmholtz theory.

The Hering theory of color vision postulates that the color (1) sensations which *appear* simple—namely: red, yellow, green (2), blue; black, white (and gray)—are in fact primary and may be divided into three pairs of mutually antagonistic sensations: red-green (2), white-black, and yellow-blue. (This is more a summary of psychological experience than a hypothesis.) Hering assumes further that the color sensations are to be attributed to disturbances of the balance between activity (katabolism) and repair (anabolism) in certain nervous tissue, the sensations red, white, and yellow corresponding to an excess of activity over repair (katabolic change), the antagonistic green, black, and blue to excess of repair over activity (anabolic change), while a complete balance between katabolism and anabolism results in the sensation of (neutral) gray.

Hering's choice of the colors to be designated as katabolic resulted either from an attempt by Hillebrand (3) to explain the Purkinje phenomonen—that blue objects increase and red objects diminish in relative apparent brightness upon adaptation to low illumination—or from the classification, by artists, of red and yellow as warm colors.

Neither of these reasons seems particularly cogent; indeed, the choice is not an *essential* part of the Hering theory, for Prof. Hering himself said (4):

"Für die schwartzweisse Sehsubstanz, welche also jetzt

an die Stelle der in der fünften Mittheilung als Sehsubstanz überhaupt bezeichneten Substanz tritt, habe ich angenommen, dass ihre Dissimilirung dem Weiss, ihre Assimilirung dem Schwartz entspricht; *für die blaugelbe und rotgrüne Substanz lasse ich vorerst ausdrücklich dahin gestellt sein, welche Farbe die D-Farbe und welche die A-Farbe ist.*"

This selection by Hillebrand (**3**) of red and yellow as katabolic colors was certainly accepted by Hering, but von Kries has shown (**5**) that as an explanation of the Purkinje phenomenon it is neither necessary nor sufficient. There are, moreover, several reasons for making another choice.

The sensations resulting from the passage of a uni-directional electric current with one electrode over the shut eyelid are (**6**) a bright violet when that electrode is anode and dark yellow-green when it is cathode, with a flash in the same sense on making, in the opposite sense on breaking the circuit. Resolving these color complexes into the primary color sensations of Hering: with anode on the eyelid white, blue, and red are seen; with cathode, black, yellow, and green. Since the nerve endings are at the back surface of the retina—and directed toward the pigment epithelium, the black inner lining of the globe of the eye—when the electrode over the eyelid is anode the current entering the eyeball at and near the pupil will leave it by way of the outwardly directed nerve endings of the retina, which will therefore behave as 'physiological cathodes'; conversely with the cathode on the eyelid, the nerve endings will become 'physiological anodes.' Now Pflüger's Laws (**7**) for the effects of the electric current on nerves state that stimulation occurs at the cathode at make and during the passage of the current, and at the anode after the current has ceased to flow; a decrease in sensitiveness is observed at the anode at make and during the passage of the current, and at the cathode when the circuit is broken. Hence, when the nerve endings are stimulated electrically (positively in Pflüger's sense), activity exceeds repair and the sensation is the resultant of the katabolic colors white, blue, and red; when the current is reversed, that of the anabolic (**8**) colors, black, yellow, and green.

XUM

Observation of the chromatic effects after exposure to the glare from snow in sunshine suggest similarly the association of red and blue, since white objects then appear rose-pink, and black ones yellow-green (**9**). A consideration of the probable mechanism of color vision about to be described gives additional support to the view that red, white, and blue are the katabolic colors.

The origin of visual sensations is almost universally ascribed to the presence of light-sensitive substances in the retina. The only one of these heretofore isolated, the visual purple (**10**) or rhodopsin, is fairly stable at body temperature or below in the dark, but is bleached by light from *all* parts of the spectrum at rates dependent on the intensity and wave-length. There is no evidence whatever that light of any wave-length causes a reversal of this decomposition process. Assuming similar properties for the as yet undiscovered substances, the nervous response of the retina is the result of a sort of 'trigger action,' in which the spontaneous decomposition of these unstable compounds is accelerated, in chemical parlance 'catalyzed,' by light of suitable frequency.

The combination of 'complementary' colors, in various ways, to produce gray or white is conclusive psychological evidence that the effects of such luminous stimuli do in some manner neutralize one another. The perhaps most obvious explanation, that their effects on the light-sensitive material of the retina are antagonistic, is hardly tenable; it is quite improbable that the decomposition of any substance, sufficiently unstable to have the requisite sensitiveness to light to account for the vision of human beings and of animals, should be reversed or appreciably retarded by light of any frequency. Nor is this a criticism of the Hering theory, for Prof. Hering took pains to state (**11**): "*Ueber die ersten, unmittelbaren Wirkungen des Lichtes im peripheren Auge sagt meine Theorie gar nichts aus.*" In the absence of a photochemical explanation, the mutual neutralization of complementary colors requires for its interpretation a nervous mechanism.

The presumable purpose and evident result of this mechanism is to base chromatic sensations not on the total amount of (say) red light falling on the retina, but on its excess over or deficiency from that which would be present in white light of the same intensity. That is, the nerves are so connected that stimulation of the 'white-black' fibers produces an inhibitory (**12**) effect on the nerves of chromatic sense just sufficient, for white light of any intensity, to neutralize the effect of the direct stimulation by the light, and thus to make the resultant sensation achromatic.

The assumed mechanism is shown diagrammatically (**13**) in Fig. 1. At the extreme left is the layer of rods and cones

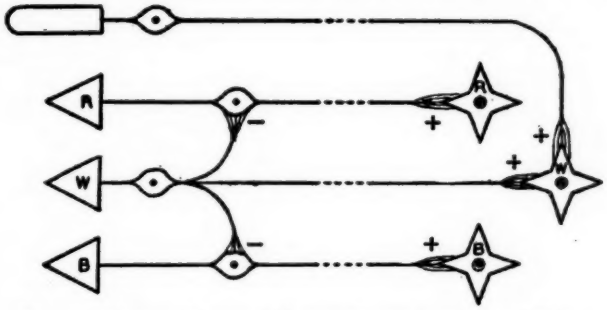

FIG. 1. Diagram of Assumed Nervous Connections: Normal Vision

in which the breaking down of the visual pigments by light produces nervous stimulation; next the bipolar cells, with inhibitory synapses, indicated by minus signs, from the achromatic to the chromatic cells, and finally the synapses with the cells of the central nervous system. The rod fiber and the fiber from the 'white' cone are shown leading to the same cell, since both the rods and the cones contribute to acromatic sensation, and their effects are introspectively indistinguishable. It is known that visual nervous impulses pass through several more synapses than are shown, but these apparently are chiefly (**14**) relays, and as such have been omitted from the diagram.

Satisfactory histological evidence is as yet wanting as to whether a single cone contributes to more than one of the

three visual senses, or, on the other hand, whether differences in the cones exist corresponding to a difference in function (15). It must, however, be borne in mind that the only necessary difference is in the visual pigment which they contain. In view of the probable shortness of life of the cone pigments in comparison with the time involved in the isolation of 'visual purple,' the rod pigment, it is not surprising that none (16) of the cone pigments have yet been discovered.

With such a mechanism, it can be seen that the intensity of the 'anabolic' chromatic sensations will be due to *and therefore limited by* the response of element *W* in Fig. 1 to the stimulating light (the 'white-intensity'), while the 'katabolic' chromatic sensations will not be limited in this way. Since the hue of the light of greatest luminous efficiency is yellow-green, while the feebly luminous but chromatically intense ends of the spectrum are red and blue, the above criterion makes yellow and green anabolic colors, in agreement with the conclusions drawn from the sensations produced by electrical stimulation, while red and blue are the katabolic color sensations.

Considering cone vision alone, there are three light-sensitive substances the products of whose decomposition stimulate three sets of nerve fibers. Separate stimulation (17) of the first set will produce a pure sensation of *red;* of the third set, of *blue;* while stimulation of the second set will produce directly a sensation of white and indirectly, *i.e.*, through the assumed red- and blue-inhibitory mechanisms, sensations of green and yellow—in the aggregate a *bright yellow-green.* Now the primary colors of the Young-Helmholtz theory are red, blue, and a bright yellow-green (18), usually referred to simply as 'green.' At the same time the fundamental *sensations* are the three pairs of colors (1) of the Hering theory: red-green, white-black, and blue-yellow. *For normal vision,* then, the assumed mechanism is in complete accord with both the Young-Helmholtz and the Hering theories.

Much confusion has resulted from the use of the name

'green' for two quite distinct colors: by Hering and others for the hue complementary to red (**19**), by Helmholtz, Abney, Mrs. Ladd-Franklin, and others for a color which in Hering's notation is a *bright yellow-green*. For those who prefer the first usage, the names 'chlor' and 'cyan' are suggested for the hues intermediate, respectively, between yellow and green, and between green and blue. For abbreviations, the Greek initials X and K may be used. In the Young-Helmholtz theory, then, the primary colors are red, chlor, and blue; in the (modified) Hering theory the fundamental hues are red, yellow, green, and blue—the katabolic color sensations, red, white, and blue.

Of the many other theories of color vision, no attempt will be made to give an enumeration, much less consider them in detail. Two theories, however, will be considered at this point, those of Mrs. Ladd-Franklin (**20**) and of Troland (**21**).

Troland assumes *five* light-sensitive substances, corresponding to the colors red, yellow, green, blue, and white, and a 'complementation center' which prevents one or the other of a pair of complementary colors from reaching consciousness. The present theory differs in that it identifies the 'yellow' and 'green' substances with one another, and in giving a somewhat different mechanism for the 'complementation center.' This last, however, is a difference of opinion as to the nature of the nervous impulse rather than as to color vision. Troland gives no reason for assuming *five* rather than *four* substances.

The theory of Mrs. Ladd-Franklin is a genetic one; that there was originally one light-sensitive substance whose stimulation produced the sensation of white, that in the course of evolution this substance 'dissociated' into two, respectively 'yellow' and 'blue,' and that the former again dissociated into two substances giving the sensations of red and of 'green' (chlor) (**22**). In the four possible cases of simultaneous stimulation only the fundamental response, yellow or white, results in two cases, while with red + blue and 'green' (**22**) + blue, the colors are seen simultaneously. So far as concerns normal vision at the present time, this

theory does not differ from that of Young and Helmholtz, hence it is compatible with any mechanism of color vision consistent with that theory, as the mechanism described in this article has been shown to be.

It remains to consider the probable course of development of the color sense. To begin with, it is a fundamental principle in evolutionary theory, that any considerable change in any organ is the sum of a number of alterations each simple enough to occur by 'accident' and each of sufficient merit, when combined with the previous changes, to ensure its survival. There is good reason to believe that vision was originally a simple sense, for which the action of light on *one* light-sensitive substance was the 'adequate' stimulus. The simplest change in this system would be the admixture, with the substance, of related substances having similar but not identical absorptions; the increased range of sensitiveness would give this modification 'survival value.' The next step in development would be an accidental and partial segregation of the constituents of the mixture into different elements of the retina. The resulting power of discriminating color differences would have survival value; selection would tend to increase (**23**) the extent of the segregation, and the nervous connections would in time be so modified as to make the best use of this new power. If it be assumed that the mixture formed in the first process was one containing three constituents, and this was subsequently resolved by the segregation of first one and then another of the added substances, these segregations would be precisely the 'dissociations' postulated by Mrs. Ladd-Franklin, which become much more comprehensible if her original light-sensitive substance is specifically assumed to have been a mixture (**24**) of related compounds.

Besides accounting for chromatic vision in normal individuals, a theory of color vision is expected to account for contrast, fatigue, and after-images; all of which can (and do) occur in totally 'color-blind' persons, and for the variety of aberrations in chromatic sense grouped together under the name of 'color blindness.'

The phenomena of contrast, fatigue, and after-images, as has been said, are substantially the same for achromatic as for chromatic vision; hence any explanation consistent with the facts of form and brightness perception may, in general, be combined with *any* hypothesis as to color vision. The phenomena may be classified as to whether the effect is in the same direction as the cause (positive) or in the opposite sense (negative), and as to whether it is a subsequent effect at the same place, or a simultaneous effect at another part of the retina (**25**), giving the following four types of effect: simultaneous positive, commonly called 'irradiation'; simultaneous negative, commonly called 'simultaneous contrast' or 'spatial induction'; subsequent positive, known as 'persistence of vision' or 'positive after-image'; and subsequent negative, known as 'negative after-image,' 'successive contrast' or 'temporal induction.' These phenomena will be considered in two groups, according as they are positive or negative.

The 'positive' effects, irradiation and persistence of vision, are due to a spreading in space or time, respectively, of the stimulation produced by the light (**26**). Both effects are best observed with brief and intense stimulation.

The 'negative' effects, simultaneous contrast and contrasting after-images, are, unlike the positive, due not so much to the direct effects of the light as to the reaction of the eye, or rather to a combination of the two. The eye is known to be capable of functioning over a very great range of physical intensity of light, and a considerable range of light quality, or color. It is not that the eye is capable of perceiving at once all this variety of intensities and colors, but that it adapts itself to the prevailing tone of the field of vision, and when so adapted is very sensitive to small differences from that mean. The analogy with the form vision of the eye may help to illustrate this: by concentrating most of the retinal perceptive elements in a small region and directing the eye by means of its (extrinsic) muscles, the center of the retina is directed to the point of interest, and niceties of form and movement are perceived there, while the more

scattered elements of the peripheral retina serve as sentinels to warn the mind of the presence of other objects deserving attention. The color (**1**) adaptation of the eye is due in part to the decrease in light-sensitive material in the eye as a result of previous exposure, and, so far as concerns intensity, to the change in size of the pupil. These are, however, quantitatively inadequate, and reasons will be given for believing that the phenomena of adaptation involve a number of retinal processes.

The visible retinal changes (**27**) under illumination comprise a movement of epithelial pigment forward, surrounding the rods and cones, and a contraction of the muscle-like inner segment, or 'myoid,' of the cones which draws them inward away from the pigment epithelium. A movement of the rods in the opposite direction has recently been demonstrated in *Alligator Mississippiensis* by Laurens and Detwiler (**27**). In any case, the result is that the rods become almost completely surrounded by pigment, the cones partly so, shielding them in part from the increased intensity of the light. Engelmann (**28**) has shown that these effects occur in both eyes when only one is illuminated; hence, like the pupil reflex, they are due to impulses from the brain, passing in this case along the centrifugal or 'retino-motor' fibers of the optic nerve. These changes require about ten minutes in the light for completion, and revert in the course of two hours in the dark; a very considerable adaptation to change in illumination takes place in a much shorter time. To account for this, it is suggested that the centrifugal fibers of the optic nerve act also on the synapses of the ganglionic layers of the retina, facilitating or inhibiting (**29**), as may be required, the passage of impulses to the brain. Adaptation is thus postulated to depend not only on the pupillary reflex and a movement of pigment, of cones and perhaps of rods, but there is also a rapid nervous adjustment to the altered conditions.

These retinal adjustments are *continuous* with respect both to place and to time. While they can tone down very considerable contrasts between widely separated parts of the

retina, or at very different times, a sudden discontinuity is not masked by them but appears at its true value (**30**).

The two types of after-image (positive and negative) for moderate visual stimuli almost completely compensate for one another. For more intense stimuli, since their laws of development and decay are not identical (**31**), first one and then the other will prevail, with the production of a series of recurrent images (**32**). The balance between the two can be upset by a marked change in the illumination, the result depending on the stage of recovery from the original light stimulus (**33**). The usually complete compensation protects consciousness from a confusion of past and present events.

The *phenomena* of 'color blindness' are by this time pretty well agreed upon. Even the supposedly unanswerable question as to the sensations of the color-blind has been settled by the convergent testimony of the more intelligent color-blind observers (**34**) and of the rare cases of unilateral color blindness. Much of the disagreement in this field has been caused by a forgetfulness on the part of the advocates of the various theories of the self-imposed limitations of those theories. The upholders of the Young-Helmholtz theory, which deals confessedly only with the immediate effects of light at the retina, have assumed without reason that the *sensations* corresponding to each of the three receptive elements present in the normal eye will remain the same in all sorts of abnormalities of vision; while Hering and his followers have been equally ready to leave the, for them, safe ground of the sensations of the color-blind to make predictions as to such physical facts as the location of the neutral zone in the spectrum as seen by the color-blind. Similarly the attempt has been made to reconcile theories which take account of cone-vision only, with observations made without any adequate assurance of using only the rod-free area of the retina. In a word, most of the difficulties in the interpretation of color blindness have been due to using limited theories without due regard to their limitations.

To take complete account of the abnormalities of color vision, account must be taken (**35**) of (1) the absorption of

light by the lens and the other structures through which the light passes before reaching the rods and cones, (2) the light-sensitive substances in the rods and cones, (3) the interconnections of the nerve fibers from those receptors, and (4) the entry into the cortical centers and 'consciousness' of the impulse in those fibers. As a chain is no stronger than its weakest link, reduction of normal 'trichromatic' vision to 'dichromatic' may occur at any of the four stages. A pigmentation so deep (**36**) as to prevent one of the light-sensitive substances, *e.g.*, the blue-perceiving one, from receiving any stimulus; the absence of one of the light-sensitive substances, of one set of nerve fibers, or of one set of perceptive centers, would alike give a subject for whom color (**1**) would be two- and not three-dimensional. A given color defect may thus be referred to possible structural differences at four different 'levels,' distinction between which depends on a study of their separate effects.

The effects of pigmentation of the lens, etc., may be imitated by wearing suitably colored spectacles, and the measurement of the pigmentation, though presenting difficulties, is after all a purely physical measurement.

Deficiencies of the light-sensitive substances of the retina may be produced temporarily by the method of Burch (**37**), by exposure to strong and nearly monochromatic light. Thus after exposure to red light, red appears black, and green and white are indistinguishable; after blue, yellow looks like white, and only red and green are seen; while after fatigue by yellow-green (chlor) (**22**), the spectrum reduces to patches of red and blue, the latter grading as usual into violet. A narrow band of white may separate the patches, or they may grade into one another, according to the completeness of the fatigue. As pointed out while considering the Ladd-Franklin theory, it is quite likely that even though only three light-sensitive substances occur in the cones, the segregation of them may be incomplete (**38**). To distinguish between a mixture of pigments in the cones, and an 'overflow' of stimulating effect from one set of nerve fibers to another, would require careful and well-chosen experiment.

XUM

Cerebral inability to receive chromatic sensations is apparently to be assumed in certain recorded cases of 'hysterical color blindness.' Such inability, if structural and congenital, would constitute permanent color blindness no matter how perfect the retinal machinery might be.

From what has been said, it can be seen that possible defects in the known parts of the visual machinery will account for more kinds of color blindness than have been described. Some of the disagreements as to the behavior of the various types may have been due to classing unlike cases together.

In Fig. 2 are shown a few of the possible deviations from

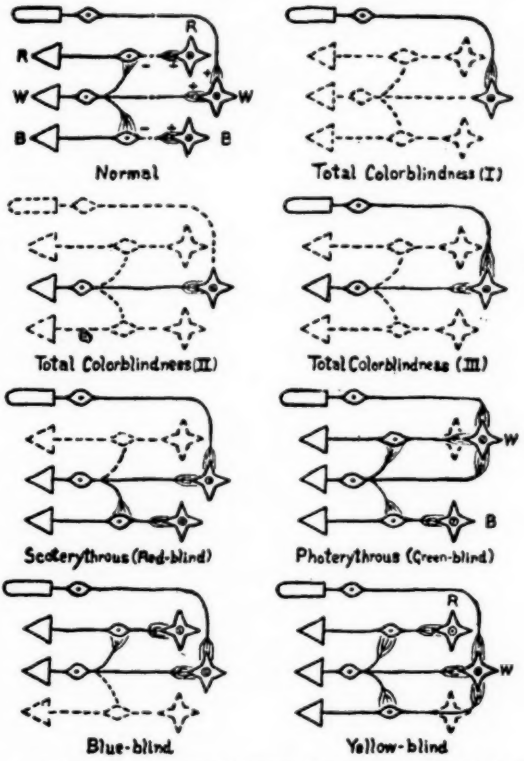

FIG. 2. Diagrams of Assumed Nervous Connections: Color Blindness

normal of the chromatic sense. The diagram of Fig. 1 is given in miniature for comparison. Complete lack of cone vision would give a type of total color blindness (Fig. 1) which would be characterized by 'day blindness,' that is, discomfort at high and even moderate intensities of illumination, by low acuity and by an absence of the Purkinje effect, the visibility curve being at all intensities the same as for normal observers at very low intensities. Lack of rod vision and of both chromatic senses would give a type of total color blindness (Fig. 2) characterized by 'night blindness,' normal acuity and an absence of Purkinje effect, the visibility curve remaining unchanged down to the elevated threshold of the subject. Finally, with only the chromatic senses wanting, a type of total color blindness (Fig. 3) with normal acuity and Purkinje effect would result. Lack of the entire red-perceiving apparatus would give the scoterythrous (red-blind, protanopic) form of color blindness, in which the red end of the spectrum is not seen at all; defects only in the central nervous system would give the photerythrous (green-blind, deuteranopic) type in which red light has an even higher luminosity than normal, though it is not seen as red. Similar defects in the blue-perceiving apparatus would give, similarly, 'blue-blind' and 'yellow-blind' subjects. Yellow-blue blindness is so much rarer than red-green that the subdivision into types has not been attempted. It will be seen that many other abnormalities than those shown can occur (**39**).

That compounds of closely related chemical composition may differ in color sufficiently to account for the sensation curves for human vision, is shown in Fig. 3 which compares with those sensation curves computed from the data of König and Dieterici (**40**) the spectrophotometric absorption curves for 'crystal violet,' *i.e.*, hexa-methyl-pararosaniline, in the form of its salts (**41**) with one, two, and three molecules of hydrochloric acid, and for the mono-hydrochloride of rosaniline (**42**) itself. It is not to be concluded from this that the light-sensitive substances of the eye are derivatives of tri-phenylmethane; the retinal pigments are most probably pyrrole derivatives, like chlorophyll and haemoglobin.

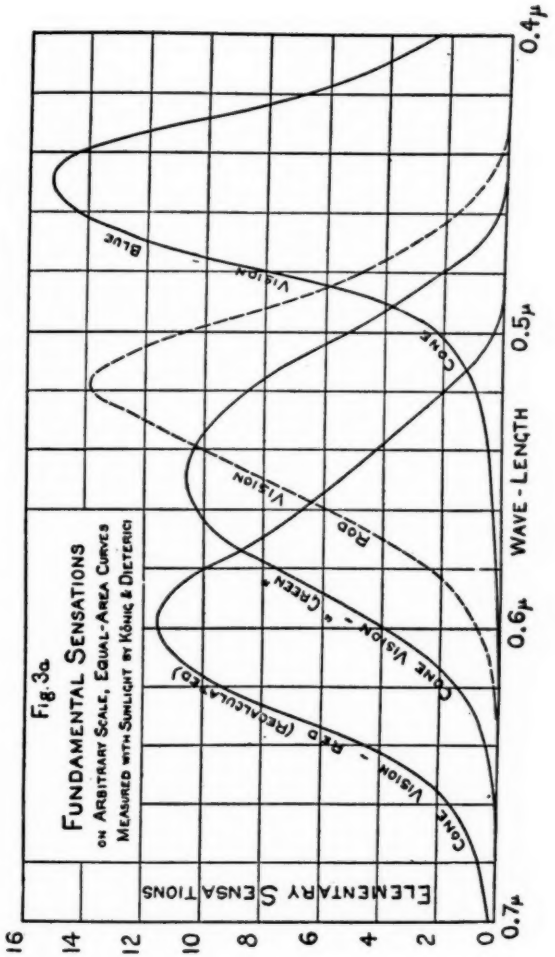
Fig. 30.
FUNDAMENTAL SENSATIONS
ON ARBITRARY SCALE, EQUAL-AREA CURVES
MEASURED WITH SUNLIGHT BY KÖNIG & DIETERICI
ELEMENTARY SENSATIONS
16
14
12
10
8
6
4
2
0
0.7μ
0.6μ
0.5μ
0.4μ
WAVE-LENGTH
CONE VISION - RED (RECALCULATED)
CONE VISION - "GREEN"
ROD VISION
CONE VISION
BLUE - VISION

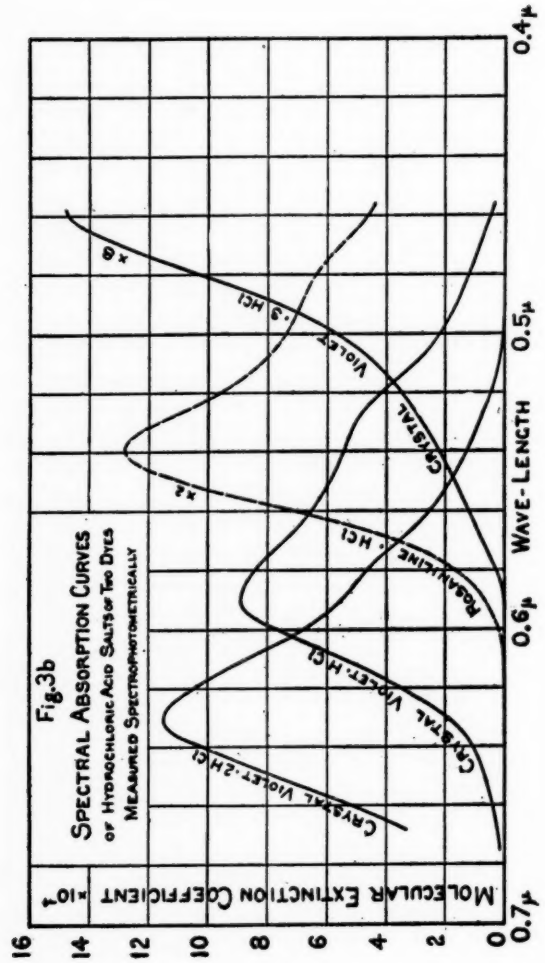
Fig.3b
Spectral Absorption Curves
of Hydrochloric Acid Salts of Two Dyes
Measured Spectrophotometrically
Molecular Extinction Coefficient ×10⁴
16
14
12
10
8
6
4
2
0
0.7μ
0.6μ
Wave-Length
0.5μ
0.4μ
Crystal Violet·2HCl
Crystal Violet·HCl
Rosaniline·HCl
Crystal Violet ·3 HCl
×2
×3

Summary

1. By assuming that the cones of the retina contain three light-sensitive substances similar to 'visual purple'—the pigment of the rods—but less stable than that substance, and that the antagonistic action of complementary colors is to be referred to a nervous mechanism, a theory of color vision has been derived which agrees with the Young-Helmholtz theory as to the retinal processes associated with vision.

2. Its psychological implications agree with those of the Hering theory, except that blue rather than yellow is to be considered a 'katabolic' color.

3. If the primitive light-sensitive substance of the theory of Mrs. Ladd-Franklin be assumed to have been a *mixture* of related substances, the two theories give the same picture of the development of the color (chromatic) sense.

4. The theory of L. T. Troland differs in assuming one more light-sensitive substance.

5. For the second primary of the Young-Helmholtz theory, the name 'chlor' is suggested, to avoid confusion with the distinctly different hue called 'green' by the psychologists.

Notes

(1) In this article the terms 'color' and 'chromatic' are used in the senses recommended by Mrs. Ladd-Franklin, 'On Color Theories and Chromatic Sensations,' Psychol. Rev., 1916, **23**, 238, *i.e.*, 'color' applies to all visual sensation qualities,—including black, white, and gray—while 'chromatic' is restricted to the 'bunte Farben.' Instead of 'chroma,' the English equivalent 'hue' is used.

(2) See, however, the discussion of the meaning of the term 'green' in Psychol. Rev., 1923, **1**, 60–61.

(3) Hillebrand, *Sitzungsb. d. k. Akad. d. Wiss. Wien*, 1889, **98** (3), 70.

(4) E. Hering, 'Zur Lehre vom Lichtsinne,' 1878, p. 119.

(5) von Kries, *Zsch. f. Psychol.*, 1896, **9**, 81–123.

"Was die Erscheinung im einzelnen angeht, so ist sie für mich am deutlichsten zu beobachten, wenn ich aus homogenem spektralen Rot und Grün ein Gelb mische, welches einem reinen spek-

tralen Gelb (mit einem sehr geringen Weisszusatz) gleich erscheint. Habe ich eine solche Gleichung für eine peripherische Netzhautstelle hergestellt und vermindere (durch Verkleinerung des Okularspaltes), die absolute Intensität beider Felder gleichmässig, so erscheint (immer mit dem gleichen peripherischen Netzhautteil) das gemischte Feld deutlich blasser und lichtstärker."

P. 93:

"Da nun die Stäbchenhelligkeit im Blau schon erheblich geringer ist, als im Grünblau (etwas rotwärts von F), so lässt sich auch hier noch leicht übersehen, dass bei Lichtverminderung das aus Rot und Blaugrün gemischte Weiss das Uebergewicht über das aus Gelb und Blau gemischte erhalten muss.

"Die Einrichtung meines Spektralapparates gestattet eine Ausführung des Versuches nicht genau in dieser Form. Es konnte aber ein unzerlegtes Weiss mit einem aus Rot und Blaugrün oder mit einem aus Gelb und Blau gemischten verglichen werden. Stelle ich die Mischungen für eine exzentrische Stelle zutreffend her und schwäche dann ab, so verdunkelt sich das unzerlegte Weiss deutlich stärker, als die Rotgrünmischung. Eine Mischung aus Gelb und Blau verdunkelt sich sehr annähernd gleich, wie das unzerlegte Weiss; eine Mischung aus Grünlichgelb und Violett etwas schneller."

(6) W. H. R. Rivers, E. A. Schaefer's 'Textbook of Physiology,' II., 1900, 1097.

G. E. Müller, *Zsch. f. Sinnesphysiol.*, 1897, **14**, 40.

F. Gotch, E. A. Schaefer's 'Textbook of Physiology' II., 1900, 517.

(7) F. Gotch, E. A. Schaefer's 'Textbook of Physiology,' II., 1900, 494–518.

Pflüger, 'Electrontonus,' Berlin, 1859.

(8) In order to account for an effect with a 'descending' current, it is necessary to assume a certain degree of nervous activity in the absence of any light stimulus.

(9) W. H. R. Rivers, E. A. Schaefer's 'Textbook of Physiology,' II., 1900, 1095–6.

Fuchs, *Arch. f. Op. th.*, 1887, **33**, 4–73.

A similar effect is described as produced by the drug santonin.

(10) This is a translation of the German 'Sehpurpur'; 'visual crimson' would be a better translation.

(11) E. Hering, Pflüger's *Arch. f. d. ges. Physiol.*, **41**, 39.

(12) Such a mechanism exists in the central nervous system in the inhibitory control of spinal reflexes by the brain, and in the 'reciprocal innervation' of the skeletal musculature, by which stimuli produce in addition to reflex contraction of the appropriate

muscles, an actual decrease in the tonus of the antagonistic muscles, indicating an inhibition of the normal activity of their motor nerves.

(13) The retina is so arranged that light reaches the layer of rods and cones through the layer of ganglion cells and fibers shown to the right of the rods and cones, and not as shown in the diagram.

(14) Another function of these synapses will be considered when dealing with spatial induction, *i.e.*, simultaneous contrast.

(15) See the discussion of this question by L. T. Troland, *J. Opt. Soc. Amer.* 1920, **4**, 183. The double cones of reptiles are an instance of such a difference, cf. footnote 27.

(16) Some of the earlier investigators reported a light-sensitive 'visual yellow,' a claim which later, more careful, and presumably less rapid, work has failed to substantiate.

(17) There appears to be no wave-length of light which stimulates only one set of nerves. Consequently the primary colors of *all* the theories of color vision are abstractions which are only imperfectly represented by any color of actual light.

(18) Helmholtz, *Handbuch d. Physiol. Optik*, 1896, II. Aufl., p. 457. See also next note.

(19) A similar, but less serious, confusion exists, in the case of the name 'red.' In both the Hering theory and that of Young and Helmholtz,—'red' is a hypothetical color intermediate in hue between the spectral red and spectral violet; to most *physicists* the long wave-length end of the spectrum is 'red.'

(20) Christine Ladd-Franklin, *Zsch. f. Sinnesphysiol.* **4**, 211–221.

(21) L. T. Troland., *Amer. J. Physiol.*, 1913, **32**, 8–40, especially Fig. 4, p. 30.

The slightness of the difference between his 'M_y' and 'M_g' curves should be noted.

(22) See, above, the discussion of the senses in which the word 'green' has been used.

(23) There are reasons for believing that this segregation is incomplete and is likely to remain so. These will be discussed when considering color blindness.

(24) Both plant pigments and synthetic dyes are usually mixtures of substances of more or less different color.

(25) Logically there is a third category; that of subsequent effects at other parts of the retina than that stimulated. Practically this seldom requires separate consideration.

(26) Physical scattering of light in the eye contributes to irradiation, but usually only to a very limited extent.

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(27) These changes have been studied chiefly in the retina of the frog, but there is reason to believe that they occur in the eye of man and other mammals. For the phenomena in the retina of *Alligator Mississippiensis*, H. Laurens and S. Detwiler, *J. Exp. Zoöl.*, 1921, **32**, 207–234.

(28) Engelmann, *Arch f. d. ges. Physiol.*, 1885, **35**, 498.

(29) To account for color adaptation, it is necessary to assume sets of centrifugal fibers for each of the color senses.

(30) This is a reversal of the usual point of view. It is customary to consider the observed difference between the centers of two large fields as the true difference, which is somehow or other augmented at the junction line by 'contrast.' With a line of black between the fields the edges of the fields are brightened, but the contrast hues are developed in the black line and therefore lost. It is a well-known fact that 'contrast colors,' either simultaneous or successive, are difficult to observe if they are made to appear on a surface much brighter or darker than the field producing them. This is apparently a psychological fact related to the effective reduction of the sourness of lemonade by the addition of sugar, or the suppression of other cutaneous sensations by pain.

(31) The positive images, being due to a spreading or persistence of the products of the action of the light will increase proportionally with it, while the negative will increase more nearly as the logarithm of exposure.

(32) L. T. Troland has shown, however, that many observed series of recurrent images are due to a periodic fluctuation in pupil diameter.

(33) L. T. Troland, *Amer. J. Physiol.*, 1917, **28**, 497–503.

(34) As Dr. W. Pole, *Phil. Trans.*, 1859, **149**, 323.

(35) F. C. Donders (Gräfe's *Archiv. f. Ophthalmol.*, 1881, **27**, 170) and, more recently, H. K. Schjelderup (*Zsch. f. Sinnesphysiol.*, 1920, **51**, 19–45) have taken account of the phenomena at different "levels." As Schjelderup, "der besseren Übersicht halber," has omitted the black-white process from his diagrams, comparison with those of this paper is not easy; the outstanding difference is that he postulates interaction of the two chromatic apparatus, and comparative independence from the achromatic.

As a partial analogy, blindness may be due to (1) cataract, (2) retinal injury or disease, (3) defects of the optic nerve, or (4) brain lesions.

(36) This degree of pigmentation probably never occurs, but

pigmentation sufficient markedly to alter the 'color-equations' is not uncommon.

(37) 'Artificial Color Blindness,' G. J. Burch, *Phil. Trans.* B., 1899, **191**, 1.

(38) The observation of Burch that fatigue to violet produces different effects from fatigue to red+blue supports this, and the studies of Abney on degrees of red- and green-blindness indicate that the red-perceiving substance in some way contributes to white sensation.

The admixture may be accounted for teleologically as follows: The closure of the pupil depends on the brightness of the entering light, hence an eye to which red light has a brightness value is less liable to injury from admitting excessive amounts of red and infra-red radiation.

(39) Even the identification of the defects pictured with the more commonly observed types of color blindness requires verification. Thus, the distinction between the scoterythrous and photerythrous forms of (red-green) color blindness is more probably due to different degrees of completeness of segregation of the light-sensitive substances, that is, of freedom of the white-perceiving substance ('green-perceiving' according to Helmholtz) from admixture of the red-perceiving substance, than to any difference in the nervous machinery proper. (See the preceding note and the discussion to which it refers.)

(40) A. König and C. Dieterici, *Zsch. f. Sinnesphysiol.*, 1893, **4**, 241–347. These curves are intended to represent the sensation value of monochromatic light of various wave-lengths for the different light-sensitive substances, rather than necessarily for individual perceiving organs in the normal eye. For this reason, and also because measurements on color-blind observers are less ambiguous, the data for mono- and di-chromatic observers, p. 256, have been used.

The blue curve is that common to all the observers except Beyssell; the rod-vision (visual purple) curve is the luminosity curve for Beyssell, a monochromat; the 'green' curve is the mean of the 'warm' curves for two 'red-blind' observers, while the 'red' curve has been computed on the assumption that the 'warm' curve of a 'green-blind' observer is composed of equal parts of the fundamental 'red' and 'green' curves,—by subtracting the 'green' curve already selected from the sum of the 'warm' curves of the two green-blind observers.

(41) E. Q. Adams and L. Rosenstein, *J. Amer. Chem. Soc.*, 1914, **36**, 1452–73.

(42) Para-rosaniline mono-hydrochloride is tri-amino-tri-phenyl-methyl chloride. Rosaniline is a mono-methylated para-rosaniline. The absorption curve of rosaniline was measured, using a Schmidt and Haensch spectrophotometer in the Nela Research Laboratories.

MENTAL REACTIONS TO SMELL STIMULI

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The reactions of a subject to different smell stimuli depend on the quality and quantity of the osmyl, or substance producing the stimulus, and on the physiological and psychological condition of the subject. Indeed, the complexity of the chemical and physical factors involved in the process of smelling is as bewildering as the complexity of the reactions evoked, a complexity which dates back to the era when life itself evolved and began to become aware of its chemical environment.

Leaving aside what may be termed purely physiological reactions such as olfactory reflexes, vaso-motor effects, etc., and problems of fatigue, both physiological and psychological, mental reactions to smell stimuli may here conveniently be grouped as direct and indirect. Direct reactions are chiefly the perception of the quality and quantity of a smell and the affect immediately produced. Indirect reactions are the associations, with or without affective tone, subsequently evoked.

The quality of a smell is referred either to the osmyl itself, or to associated senses, or to associated but more remote ideas. Unfortunately the language has not yet evolved words denoting the quality of a smell, and osmics, the science of smell, is handicapped by the lack of an adequate terminology. All sorts of adjectives are employed by the subject to describe the quality of the smell and the affect produced, *e.g.*, sweet, sharp, strident, sour, soft, dry, wet, woolly, soothing, exciting, clean, cool, hot, bland—to name but a few of those usually employed.

The pleasantness or unpleasantness of a smell sensation may depend in certain instances on the affective tone of a more remote association, but it was found that the affects

could be tabulated fairly reliably under the headings entirely unpleasant (−−), more unpleasant than pleasant (−+), more pleasant than unpleasant (+−), and entirely pleasant (++). In the case of certain osmyls, *e.g.*, musk and ferric valerian, a marked divergence between the affects produced in male and female subjects has been noted, whereas in other cases there may be a remarkable unanimity among the subjects. To name the two extremes, otto of roses was always found to be a ++ smell, whereas asafœtida received a unanimous verdict of −−, unanimous, that is, if we except the opinion of a parosmic lady who stated that asafœtida had a nutty smell, and rated it ++. Other osmyls, clove oil, for instance, are considered as being −−, −+, +−, or ++. A pleasant affect may be produced together with an association recalling an entirely unpleasant event. On re-examining the same subject after an interval of several weeks the plus minus signs were confirmed in the majority of cases, even though associations formed were frequently different from those first recorded. Variations could sometimes be ascribed to tidal phenomena in metabolism and the intimate relation between the olfactory sense and the sex life noted.

Associations are observed to follow different paths. Menthol may evoke the memory of a peppermint candy, a mint leaf, or smelling salt. The candy, leaf, or bottle may or may not be visualised. There may be a concomitant sweet taste sensation, a tactile sensation, and a temperature sensation, and each of these may link up with other memories. The reaction to menthol may consist in the visualisation of a candy store, and an entire constellation may appear in the most minute detail. While it is possible to state that the usual associative reaction to menthol is peppermint candy, onions to asafœtida, gorgonzola to ferric valerian, hay to cumarin, it is impossible to predict individual associations. The smell of vanillin may remind one subject of chocolate, another of his grandmother, and another of a few bars of Chopin's music. Indeed, the association may not be formed via a similar smell, smell-taste, taste, or word-association, but the affect produced by smell may be similar to the affect produced by some other stimulus, and thus explain the

vanillin-Chopin association. On stimulation with cedarwood oil, one subject visualised a pair of boots seen in childhood, the association being unconsciously via the smell of boot polish, which like cedarwood oil may be considered a resinous smell. In another subject the smell of clove oil recalled a certain town. On inquiry it was found that the subject last had toothache in that town, but had not used clove oil on that occasion.

Smell stimuli are particularly useful in psycho-analysis for detecting the presence of a complex, quite apart from their value in recalling memories of events without a marked associated affect. Experiments made with the galvanometer have been successful, and complexes brought to the surface by various smell stimuli, or if the nature of the complex could not be detected immediately, further psycho-analysis was able to take a short cut. Musk is a useful osmyl for touching a sex-complex, though other substances could act in a similar way. Instead of employing a word series, a series of smells may be used as stimuli, and an osmyl should not be rejected for this purpose because the usual association is limited to taste, or to another smell. From hundreds of association experiments made, it is certain that one never knows what individual significance a smell may possess. However, it is advisable to avoid using substances in this psycho-analytic method which would overstimulate either the olfactory or the trigeminal nerve, or which are known to have too violent physiological effects. It is interesting to note that a fear-complex of about thirty years' standing was revealed by giving a subject some camphor to smell. There was an extreme psychogalvanic reflex in this instance, and the nature of the complex was quickly elicited by interrogation. The subject now associates camphor in the usual way (clothing or liniment), instead of with the emotional incident giving rise to the complex.

The purpose of this paper, however, is not so much to record the writer's experiments, as to draw attention to the need for further investigation, and to indicate a few of the directions along which research could travel with profit.

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